

# Gratitude

In appreciation and gratitude  
to The Custodian of the Two Holy Mosques  
*King Abdullah Bin Abdul Aziz Al Saud*

And

*H.R.H. Prince Sultan Bin Abdul Aziz Al Saud*

Crown Prince, Deputy Premier, Minister of Defence  
& Aviation and Inspector General

For their continuous support and gracious consideration,  
the Saudi Building Code National Committee (SBCNC)  
is honored to present the first issue of  
the Saudi Building Code (SBC).

# Saudi Building Code Requirements

201	Architectural	
301	Structural – Loading and Forces	
302	Structural – Testing and Inspection	
303	Structural – Soil and Foundations	
304	Structural – Concrete Structures	
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401	Electrical	
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601	Energy Conservation	
701	Sanitary	
801	Fire Protection	
901	Existing Buildings	

## PREFACE

The Saudi Building Code (SBC) is a set of legal, administrative and technical regulations and requirements that specify the minimum standards of construction for building in order to ensure public safety and health. A Royal Decree dated 11<sup>th</sup> June 2000 order the formation of a national committee composed of representatives of Saudi universities and governmental and private sectors. In September 2001, the Council of Ministers approved the general plan of the National Committee to develop a national building code for the Kingdom of Saudi Arabia.

To choose a base code for the Saudi Building Code, a number of Codes have been studied. The National Committee has been acquainted with the results of the national researches and the international codes from the U.S.A., Canada and Australia, also, the European Code, and Arab Codes. It has also sought the opinions of specialists in relevant Saudi universities, governmental and private sectors through holding a questionnaire, a symposium and specialized workshops, in the light of which, (ICC) has been chosen to be a base code for the Saudi Building Code.

The International Code Council (ICC) grants permission to the Saudi Building Code National Committee (SBCNC) to include all or any portion of material from the ICC codes, and standards in the SBC and ICC is not responsible or liable in any way to SBCNC or to any other party or entity for any modifications or changes that SBCNC makes to such documents.

Toward expanding the participation of all the specialists in the building and construction industry in the Kingdom through the governmental and private sectors, the universities and research centers, the National Committee took its own decisions related to code content by holding specialized meetings, symposiums and workshops and by the help of experts from inside and outside of Saudi Arabia.

The technical committees and sub-committees started their work in April 2003 to develop the Saudi Building Code that adapts the base code with the social and cultural environment, the natural and climatic conditions, types of soil and properties of materials in the Kingdom.

The Saudi Building Code Fire Protection Requirements (SBC 801) was based on the International Fire Code (IFC) 2003 edition, beside the materials published by the National Fire Protection Association (NFPA). NFPA allow the Saudi Building Code National committee (SBCNC) to utilize (NFPA) codes and standards as reference documents in part or in full.

The development process of SBC 801 followed the methodology approved by the Saudi Building Code National Committee. Many changes and modifications were made on the base code and only SI units were used throughout the Code. The changes were intended to compose a comprehensive set of provisions, to the best possible extent, for materials, environmental conditions, and construction practices prevailing in the Kingdom.

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## CHAPTER 1 DEFINITIONS

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- 1.1.1 Scope.** Unless otherwise expressly stated, the following words and terms shall, for the purposes of these code requirements, have the meanings shown in this chapter.
- 1.1.2 Interchangeability.** Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.
- 1.1.3 Terms defined in other codes.** Where terms are not defined in these code requirements and are defined in the SBC 201, SBC 501 or SBC 701, such terms shall have the meanings ascribed to them as in those code requirements.
- 1.1.4 Terms not defined.** Where terms are not defined through the methods authorized by this section, such terms shall have ordinarily accepted meanings such as the context implies. *Webster's Third New International Dictionary of the English Language, Unabridged*, shall be considered as providing ordinarily accepted meanings.

### SECTION 1.2 GENERAL DEFINITIONS

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**AEROSOL.** See Section 26.2.1.

**Level 1 aerosol products.** See Section 26.2.1.

**Level 2 aerosol products.** See Section 26.2.1.

**Level 3 aerosol products.** See Section 26.2.1.

**AEROSOL CONTAINER.** See Section 26.2.1.

**AEROSOL WAREHOUSE.** See Section 26.2.1.

**AGENT.** A person who shall have charge, care or control of any structure as owner, or agent of the owner, or as executor, executrix, administrator, administratrix, trustee or guardian of the estate of the owner. Any such person representing the actual owner shall be bound to comply with the provisions of these code requirements to the same extent as if that person was the owner.

**AIR-SUPPORTED STRUCTURE.** See Section 22.2.1.

**AIRCRAFT OPERATION AREA (AOA).** See Section 11.2.1.

**AIRPORT.** See Section 11.2.1.

**AISLE ACCESSWAY.** See Section 8.2.1.

**ALARM NOTIFICATION APPLIANCE.** See Section 7.2.1.

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**ALARM VERIFICATION FEATURE.** See Section 7.2.1.

**ALTERNATING TREAD DEVICE.** See Section 8.2.1.

**AMMONIUM NITRATE.** See Section 31.2.1.

**ANNUNCIATOR.** See Section 7.2.1.

**APPROVED.** Acceptable to the Building code official.

**AREA OF REFUGE.** See Section 8.2.1.

**ARRAY.** See Section 21.2.1.

**ARRAY, CLOSED.** See Section 21.2.1.

**AUDIBLE ALARM NOTIFICATION APPLIANCE.** See Section 7.2.1.

**AUTOMATIC.** See Section 7.2.1.

**AUTOMATIC FIRE-EXTINGUISHING SYSTEM.** See Section 7.2.1.

**AUTOMATIC SPRINKLER SYSTEM.** See Section 7.2.1.

**AUTOMOTIVE MOTOR FUEL-DISPENSING FACILITY.** See Section 20.2.1.

**AVERAGE AMBIENT SOUND LEVEL.** See Section 7.2.1.

**BARRICADE.** See Section 31.2.1.

**Artificial barricade.** See Section 31.2.1.

**Natural barricade.** See Section 31.2.1.

**BARRICADED.** See Section 31.2.1.

**BATTERY, LEAD ACID.** See Section 5D.2.1.

**BATTERY SYSTEM, STATIONARY LEAD ACID.** See Section 5D.2.1.

**BIN BOX.** See Section 21.2.1.

**BLAST AREA.** See Section 31.2.1.

**BLAST SITE.** See Section 31.2.1.

**BLASTER.** See Section 31.2.1.

**BLASTING AGENT.** See Section 31.2.1.

**BLEACHERS.** See Section 8.2.1.

**BOILING POINT.** See Section 25.2.1.

**BONFIRE.** See Section 5A.2.1.

**BRITISH THERMAL UNIT (BTU).** The heat necessary to raise the temperature of 0.454 kg of water by 0.5565°C.

**BULK OXYGEN SYSTEM.** See Section 38.2.1.

**BULK PLANT OR TERMINAL.** See Section 32.2.1.

**BULK TRANSFER.** See Section 32.2.1.

**BULLET RESISTANT.** See Section 31.2.1.

**CANOPY.** See Section 22.2.1.

**CARBON DIOXIDE EXTINGUISHING SYSTEM.** See Section 7.2.1.

**CARTON.** A cardboard or fiberboard box enclosing a product.

**CEILING LIMIT.** See Section 25.2.1.

**CHEMICAL.** See Section 25.2.1.

**CHEMICAL NAME.** See Section 25.2.1.

**CLEAN AGENT.** See Section 7.2.1.

**CLOSED CONTAINER.** See Section 25.2.1.

**CLOSED SYSTEM.** The use of a solid or liquid hazardous material involving a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases. Examples of closed systems for solids and liquids include product conveyed through a piping system into a closed vessel, system or piece of equipment.

**COLD DECK.** See Section 17.2.1.

**COMBUSTIBLE DUST.** See Section 12.2.1.

**COMBUSTIBLE FIBERS.** See Section 27.2.1.

**COMBUSTIBLE LIQUID.** See Section 32.2.1.

**Class II.** See Section 32.2.1.

**Class IIIA.** See Section 32.2.1.

**Class IIIB.** See Section 32.2.1.

**COMMERCIAL COOKING APPLIANCES.** See Section 5D.2.1.

**COMMODITY.** See Section 21.2.1.

**COMMON PATH OF EGRESS TRAVEL.** See Section 8.2.1.

**COMPRESSED GAS.** See Section 28.2.1.

**COMPRESSED GAS CONTAINER.** See Section 28.2.1.

**COMPRESSED GAS SYSTEM.** See Section 28.2.1.

**CONSTANTLY ATTENDED LOCATION.** See Section 7.2.1.

**CONSTRUCTION DOCUMENTS.** The written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of the project necessary for obtaining a permit.

**CONTAINER.** See Section 25.2.1.

**CONTAINMENT SYSTEM.** See Section 35.2.1.

**CONTAINMENT VESSEL.** See Section 35.2.1.

**CONTINUOUS GAS DETECTION SYSTEM.** See Section 16.2.1.

**CONTROL AREA.** See Section 25.2.1.

**CORRIDOR.** See Section 8.2.1.

**CORROSIVE.** See Section 29.2.1.

**CRYOGENIC CONTAINER.** See Section 30.2.1.

**CRYOGENIC FLUID.** See Section 30.2.1.

**CRYOGENIC VESSEL.** See Section 30.2.1.

**CYLINDER.** See Section 25.2.1.

**DEFLAGRATION.** See Section 25.2.1.

**DELUGE SYSTEM.** See Section 7.2.1.

**DESIGN PRESSURE.** See Section 25.2.1.

**DETACHED BUILDING.** See Section 25.2.1.

**DETEARING.** See Section 12.2.1.

**DETECTOR, HEAT.** See Section 7.2.1.

**DETONATING CORD.** See Section 31.2.1.

**DETONATION.** See Section 31.2.1.

**DETONATOR.** See Section 31.2.1.

**DIP TANK.** See Section 12.2.1.

**DISCHARGE SITE.** See Section 31.2.1.

**DISPENSING.** See Section 25.2.1.

**DISPENSING DEVICE, OVERHEAD TYPE.** See Section 20.2.1.

**DISPLAY SITE.** See Section 31.2.1.

**DOOR, BALANCED.** See Section 8.2.1.

**DRAFT CURTAIN.** See Section 21.2.1.

**DRY-CHEMICAL EXTINGUISHING AGENT.** See Section 7.2.1.

**DRY CLEANING.** See Section 13.2.1.

**DRY CLEANING PLANT.** See Section 13.2.1.

**DRY CLEANING ROOM.** See Section 13.2.1.

**DRY CLEANING SYSTEM.** See Section 13.2.1.

**EARLY SUPPRESSION FAST-RESPONSE (ESFR) SPRINKLER.** See Section 21.2.1.

**EGRESS COURT.** See Section 8.2.1.

**ELECTROSTATIC FLUIDIZED BED.** See Section 12.2.1.

**EMERGENCY ALARM SYSTEM.** See Section 7.2.1.

**EMERGENCY CONTROL STATION.** See Section 16.2.1.

**EMERGENCY ESCAPE AND RESCUE OPENING.** See Section 8.2.1.

**EMERGENCY EVACUATION DRILL.** See Section 5B2.1.

**EMERGENCY VOICE/ALARM COMMUNICATIONS.** See Section 7.2.1.

**EXCESS FLOW CONTROL.** See Section 25.2.1.

**EXCESS FLOW VALVE.** See Section 35.2.1.

**EXHAUSTED ENCLOSURE.** See Section 25.2.1.

**EXISTING.** Buildings, facilities or conditions which are already in existence, constructed or officially authorized prior to the adoption of these code requirements.

**EXIT.** See Section 8.2.1.

**EXIT ACCESS.** See Section 8.2.1.

**EXIT DISCHARGE.** See Section 8.2.1.

**EXIT DISCHARGE, LEVEL OF.** See Section 8.2.1.

**EXIT ENCLOSURE.** See Section 8.2.1.

**EXIT, HORIZONTAL.** See Section 8.2.1.

**EXIT PASSAGEWAY.** See Section 8.2.1.

**EXPANDED PLASTIC.** See Section 21.2.1.

**EXPLOSION.** See Section 25.2.1.

**EXPLOSIVE.** See Section 31.2.1.

**High Explosive.** See Section 31.2.1.

**Low Explosive.** See Section 31.2.1.

**Mass-detonating Explosives.** See Section 31.2.1.

**MOI (UN/DOTn) Class 1 Explosives.** See Section 31.2.1.

**Division 1.1.** See Section 31.2.1.

**Division 1.2.** See Section 31.2.1.

**Division 1.3.** See Section 31.2.1.

**Division 1.4.** See Section 31.2.1.

**Division 1.5.** See Section 31.2.1.

**Division 1.6.** See Section 31.2.1.

**EXPLOSIVE MATERIAL.** See Section 31.2.1.

**EXTRA-HIGH-RACK COMBUSTIBLE STORAGE.** See Section 21.2.1.

**FABRICATION AREA.** See Section 16.2.1.

**FACILITY.** A building or use in a fixed location including exterior storage areas for flammable and combustible substances and hazardous materials, piers, wharves, tank farms and similar uses. This term includes recreational vehicles, mobile home and manufactured housing parks, sales and storage lots.



**FALLOUT AREA.** See Section 31.2.1.

**FALSE ALARM.** The willful and knowing initiation or transmission of a signal, message or other notification of an event of fire when no such danger exists.

**FINES.** See Section 17.2.1.

**FIRE ALARM.** The giving, signaling or transmission to any public fire station, or company or to any officer or employee thereof, whether by telephone, spoken word or otherwise, of information to the effect that there is a fire at or near the place indicated by the person giving, signaling, or transmitting such information.

**FIRE ALARM BOX, MANUAL.** See Section 7.2.1.

**FIRE ALARM CONTROL UNIT.** See Section 7.2.1.

**FIRE ALARM SIGNAL.** See Section 7.2.1.

**FIRE ALARM SYSTEM.** See Section 7.2.1.

**FIRE APPARATUS ACCESS ROAD.** See Section 5C.2.1.

**FIRE AREA.** See Section 7.2.1.

**FIRE CHIEF.** The chief officer of the Civil Defence serving the jurisdiction, or a duly authorized representative.

**BUILDING CODE OFFICIAL.** Designated authority charged with the administration and enforcement of the code, or a duly authorized representative.

**FIRE COMMAND CENTER.** See Section 5C.2.1.

**CIVIL DEFENCE MASTER KEY.** See Section 5C.2.1.

**FIRE DETECTOR, AUTOMATIC.** See Section 7.2.1.

**FIRE DOOR ASSEMBLY.** Any combination of a fire door, frame, hardware, and other accessories that together provide a specific degree of fire protection to the opening.

**FIRE EXIT HARDWARE.** See Section 8.2.1.

**FIRE LANE.** See Section 5C.2.1.

**FIRE PARTITION.** A vertical assembly of materials designed to restrict the spread of fire in which openings are protected.

**FIRE POINT.** See Section 32.2.1.

**FIRE PROTECTION SYSTEM.** See Section 7.2.1.

**FIRE SAFETY FUNCTIONS.** See Section 7.2.1.

**FIREWATCH.** A temporary measure intended to ensure continuous and systematic surveillance of a building or portion thereof by one or more qualified individuals for the purposes of identifying and controlling fire hazards, detecting early signs of unwanted fire, raising an alarm of fire and notifying the Civil Defence.

**FIREWORKS.** See Section 31.2.1.

**Fireworks, 1.4G.** See Section 31.2.1.

**Fireworks, 1.3G.** See Section 31.2.1.

**FIREWORKS DISPLAY.** See Section 31.2.1.

**FLAMMABLE CRYOGENIC FLUID.** See Section 30.2.1.

**FLAMMABLE FINISHES.** See Section 12.2.1.

**FLAMMABLE GAS.** See Section 33.2.1.

**FLAMMABLE LIQUEFIED GAS.** See Section 33.2.1.

**FLAMMABLE LIQUID.** See Section 32.2.1.

**Class IA.** See Section 32.2.1.

**Class IB.** See Section 32.2.1.

**Class IC.** See Section 32.2.1.

**FLAMMABLE MATERIAL.** A material capable of being readily ignited from common sources of heat or at a temperature of 316°C or less.

**FLAMMABLE SOLID.** See Section 34.2.1.

**FLAMMABLE VAPORS OR FUMES.** See Section 25.2.1.

**FLASH POINT.** See Section 32.2.1.

**FLEET VEHICLE MOTOR FUEL-DISPENSING FACILITY.** See Section 20.2.1.

**FLOOR AREA, GROSS.** See Section 8.2.1.

**FLOOR AREA, NET.** See Section 8.2.1.

**FLUIDIZED BED.** See Section 12.2.1.

**FOAM-EXTINGUISHING SYSTEM.** See Section 7.2.1.

**FOLDING AND TELESCOPIC SEATING.** See Section 8.2.1.

**FUEL LIMIT SWITCH.** See Section 32.2.1.

**FUMIGANT.** See Section 15.2.1.

**FUMIGATION.** See Section 15.2.1.

**FURNACE CLASS A.** See Section 19.2.1.

**FURNACE CLASS B.** See Section 19.2.1.

**FURNACE CLASS C.** See Section 19.2.1.

**FURNACE CLASS D.** See Section 19.2.1.

**GAS CABINET.** See Section 25.2.1.

**GAS ROOM.** See Section 25.2.1.

**GRANDSTAND.** See Section 8.2.1.

**GUARD.** See Section 8.2.1.

**HALOGENATED EXTINGUISHING SYSTEM.** See Section 7.2.1.

**HANDLING.** See Section 25.2.1.

**HANDRAIL.** See Section 8.2.1.

**HAZARDOUS MATERIAL.** See Section 25.2.1.

**HAZARDOUS PRODUCTION MATERIAL (HPM).** See Section 16.2.1.

**HEALTH HAZARD.** See Section 25.2.1.

**HELIPORT.** See Section 11.2.1.

**HELISTOP.** See Section 11.2.1.

**HI-BOY.** See Section 5A.2.1.

**HIGH-PILED COMBUSTIBLE STORAGE.** See Section 21.2.1.

**HIGH-PILED STORAGE AREA.** See Section 21.2.1.

**HIGHLY TOXIC.** See Section 35.2.1.

**HIGHLY VOLATILE LIQUID.** A liquefied compressed gas with a boiling point of less than 20°C.

**HIGHWAY.** See Section 31.2.1.

**HOGGED MATERIALS.** See Section 17.2.1.

**HOOD.** See Section 5D.2.1.

**Type I.** See Section 5D.2.1.

**HOT WORK.** See Section 24.2.1.

**HOT WORK AREA.** See Section 24.2.1.

**HOT WORK EQUIPMENT.** See Section 24.2.1.

**HOT WORK PERMITS.** See Section 24.2.1.

**HOT WORK PROGRAM.** See Section 24.2.1.

**HPM FLAMMABLE LIQUID.** See Section 16.2.1.

**HPM ROOM.** See Section 16.2.1.

**IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH).** See Section 25.2.1.

**IMPAIRMENT COORDINATOR.** See Section 7.2.1.

**INCOMPATIBLE MATERIALS.** See Section 25.2.1.

**INHABITED BUILDING.** See Section 31.2.1.

**INITIATING DEVICE.** See Section 7.2.1.

**IRRITANT.** A chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of CPSC 16CFR Part 1500.41 for an exposure of four or more hours or by other appropriate techniques, it results in an empirical score of 5 or more. A chemical is classified as an eye irritant if so determined under the procedure listed in CPSC 16CFR Part 1500.42 or other approved techniques.

**KEY BOX.** See Section 5C.2.1.

**LABELED.** Equipment or material to which has been attached a label, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling is indicated compliance with nationally recognized standards or tests to determine suitable usage in a specified manner.

**LIMITED SPRAYING SPACE.** See Section 12.2.1.

**LIQUEFIED NATURAL GAS (LNG).** See Section 20.2.1.

**LIQUEFIED PETROLEUM GAS (LP-gas).** See Section 36.2.1.

**LIQUID.** See Section 25.2.1.

**LIQUID STORAGE ROOM.** See Section 32.2.1.

**LISTED.** Equipment or materials included on a list published by an approved testing laboratory, inspection agency or other organization concerned with current product evaluation that maintains periodic inspection of production of listed equipment or materials, and whose listing states that equipment or materials comply with approved nationally recognized standards and have been tested or evaluated and found suitable for use in a specified manner.

**LONGITUDINAL FLUE SPACE.** See Section 21.2.1.

**LOW-PRESSURE TANK.** See Section 30.2.1.

**LOWER EXPLOSIVE LIMIT (LEL).** See Section 25.2.1.

**LOWER FLAMMABLE LIMIT (LFL).** See Section 25.2.1.

**MAGAZINE.** See Section 31.2.1.

**Indoor.** See Section 31.2.1.

**Type 1.** See Section 31.2.1.

**Type 2.** See Section 31.2.1.

**Type 3.** See Section 31.2.1.

**Type 4.** See Section 31.2.1.

**Type 5.** See Section 31.2.1.

**MAGNESIUM.** See Section 34.2.1.

**MANUAL FIRE ALARM BOX.** See Section 7.2.1.

**MANUAL STOCKING METHODS.** See Section 21.2.1.

**MARINE MOTOR FUEL-DISPENSING FACILITY.** See Section 20.2.1.

**MATERIAL SAFETY DATA SHEET (MSDS).** See Section 25.2.1.

**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA.** See Section 25.2.1.

**MEANS OF EGRESS.** See Section 8.2.1.

**MECHANICAL STOCKING METHODS.** See Section 21.2.1.

**MEMBRANE STRUCTURE.** See Section 22.2.1.

**MOBILE FUELING.** See Section 32.2.1.

**MOI.** Ministry of Interior.

**MORTAR.** See Section 31.2.1.

**MOT.** Ministry of Transportation.

**MULTIPLE-STATION ALARM DEVICE.** See Section 7.2.1.

**MULTIPLE-STATION SMOKE ALARM.** See Section 7.2.1.

**NESTING.** See Section 28.2.1.

**NET EXPLOSIVE WEIGHT (net weight).** See Section 31.2.1.

**NORMAL TEMPERATURE AND PRESSURE (NTP).** See Section 25.2.1.

**NOSING.** See Section 8.2.1.

**NUISANCE ALARM.** See Section 7.2.1.

**OCCUPANCY CLASSIFICATION.** For the purposes of these code requirements, certain occupancies are defined as follows:

**Assembly Group A.** Assembly Group A occupancy includes, among others, the use of a building or structure, or a portion thereof, for the gathering together of persons for purposes such as civic, social or religious functions, recreation, food or drink consumption or awaiting transportation. A room or space used for assembly purposes by less than 50 persons and accessory to another occupancy shall be included as a part of that occupancy. Assembly areas with less than 69.7 m<sup>2</sup> and which are accessory to another occupancy according to Section 2A.2.2.1 are not assembly occupancies. Assembly occupancies which are accessory to Group E in accordance with Section 2A.2.2 are not considered assembly occupancies. Religious educational rooms and religious auditoriums which are accessory to mosques in accordance with Section 2A.2.2 and which have occupant loads of less than 100 shall be classified as A-3. A building or tenant space used for assembly purposes by less than 50 persons shall be considered a Group B occupancy. Assembly occupancies shall include the following:

**A-1** Assembly uses, usually with fixed seating, intended for the production and viewing of performing arts or motion pictures including but not limited to:

Motion picture theaters

Symphony and concert halls

Television and radio studios admitting an audience

Theaters

**A-2** Assembly uses intended for food and/or drink consumption including, but not limited to:

Banquet halls

Restaurants

**A-3** Assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A, including, but not limited to:

Amusement arcades

Art galleries

Bowling alleys

Mosques

Community halls

Courtrooms

Exhibition halls

Gymnasiums (without spectator seating)

Indoor swimming pools (without spectator seating)

Indoor tennis courts (without spectator seating)

Lecture halls

Libraries

Museums

Waiting areas in transportation terminals

Pool and billiard parlors

**A-4** Assembly uses intended for viewing of indoor sporting events and activities with spectator seating including, but not limited to:

Arenas

Skating rinks

Swimming pools

Tennis courts

**A-5** Assembly uses intended for participation in or viewing outdoor activities including, but not limited to:

Amusement park structures

Bleachers

Grandstands

Stadiums

**Business Group B.** Business Group B occupancy includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts. Business occupancies shall include, but not be limited to, the following:

Airport traffic control towers

Animal hospitals, kennels, pounds

Banks

Barber and beauty shops

Car wash

Civic administration

Clinic—outpatient

Dry cleaning and laundries; pick-up and delivery stations and self-service

Educational occupancies above the 12th grade

Electronic data processing

Laboratories; testing and research

Motor vehicle showrooms

Post offices

Print shops

Professional services (architects, attorneys, dentists, physicians, engineers, etc.)

Radio and television stations

Telephone exchanges

**Educational Group E.** Educational Group E occupancy includes, among others, the use of a building or structure, or a portion thereof, by six or more persons at any one time for educational purposes through the 12th grade. Educational rooms and auditoriums, which are accessory to mosques in

accordance with Section 5A.2.2 and have occupant loads of less than 100, shall be classified as Group A-3 occupancies.

**Day care.** The use of a building or structure, or portion thereof, for educational, supervision or personal care services for more than five children older than 2<sup>1</sup>/<sub>2</sub> years of age shall be classified as an E occupancy.

**Factory Industrial Group F.** Factory Industrial Group F occupancy includes, among others, the use of a building or structure, or a portion thereof, for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations that are not classified as a Group H high-hazard or Group S storage occupancy.

**Factory Industrial F-1 Moderate-Hazard Occupancy.** Factory Industrial uses which are not classified as Factory Industrial Group F-2 shall be classified as F-1 Moderate Hazard and shall include, but not be limited to, the following:

Aircraft  
 Appliances  
 Athletic equipment  
 Automobiles and other motor vehicles  
 Bakeries  
 Bicycles  
 Boats  
 Brooms or brushes  
 Business machines  
 Cameras and photo equipment  
 Canvas and similar fabric  
 Carpet and rugs (includes cleaning)  
 Disinfectants  
 Dry cleaning and dyeing  
 Electric generation plants  
 Electronics  
 Engines (including rebuilding)  
 Food processing  
 Furniture  
 Hemp products  
 Jute products  
 Laundries  
 Leather products  
 Machinery  
 Metals  
 Millwork (sash and doors)  
 Motion picture and television filming (without spectators)  
 Musical instruments  
 Optical goods  
 Paper mills or products  
 Photographic film  
 Plastic products  
 Printing or publishing  
 Recreational vehicles  
 Refuse incineration  
 Shoes  
 Soaps and detergents  
 Textiles



Tobacco

Trailers

Upholstering

Wood; distillation

Woodworking (cabinet)

**Factory Industrial F-2 Low-Hazard Occupancy.** Factory industrial uses involving the fabrication or manufacturing of noncombustible materials which, during finishing, packaging or processing do not involve a significant fire hazard, shall be classified as Group F-2 occupancies and shall include, but not be limited to, the following:

Brick and masonry

Ceramic products

Foundries

Glass products

Gypsum

Ice

Metal products (fabrication and assembly)

**High-Hazard Group H.** High-hazard Group H occupancy includes, among others, the use of a building or structure, or a portion thereof, that involves the manufacturing, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those found in Tables 2A.7.7(1) and 2A.7.7(2). (See also definition of “Control area”).

**Exception:** Occupancies as provided for in the SBC 201 shall not be classified as Group H, but shall be classified in the occupancy which they most nearly resemble.

**High-hazard Group H-1.** Buildings and structures containing materials that pose a detonation hazard, shall be classified as Group H-1. Such materials shall include, but not be limited to, the following:

Explosives:

Division 1.1

Division 1.2

Division 1.3

**Exception:** Materials that are used and maintained in a form where either confinement or configuration will not elevate the hazard from a mass fire to mass explosion hazard shall be allowed in Group H-2 occupancies.

Division 1.4

**Exception:** Articles, including articles packaged for shipment, that are not regulated as an explosive under Bureau of Alcohol, Tobacco and Firearms regulations, or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles shall be allowed in Group H-3 occupancies.

Division 1.5

Division 1.6

Organic peroxides, unclassified detonable

Oxidizers, Class 4

Unstable (reactive) materials, Class 3 detonable, and Class 4

Detonable pyrophoric materials

**High-hazard Group H-2.** Buildings and structures containing materials that pose a deflagration hazard or a hazard from accelerated burning shall be classified as Group H-2. Such materials shall include, but not be limited to, the following:

Class I, or II or IIIA flammable or combustible liquids which are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 pounds per square inch (103.4 kPa) gauge  
Combustible dusts

Cryogenic fluids, flammable

Flammable gases

Organic peroxides, Class I

Oxidizers, Class 3, that are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 103.4 kPa gauge

Pyrophoric liquids, solids and gases, nondetonable

Unstable (reactive) materials, Class 3, nondetonable

Water-reactive materials, Class 3

**High-hazard Group H-3.** Buildings and structures containing materials that readily support combustion or that pose a physical hazard shall be classified as Group H-3. Such materials shall include, but not be limited to, the following:

Class I, II or IIIA flammable or combustible liquids which are used or stored in normally closed containers or systems pressurized at less than 103.4 kPa gauge

Combustible fibers

Consumer fireworks, 1.4G (Class C, Common)

Cryogenic fluids, oxidizing

Flammable solids

Organic peroxides, Class II and Class III

Oxidizers, Class 2

Oxidizing gases

Unstable (reactive) materials, Class 2

Water-reactive materials, Class 2

**High-hazard Group H-4.** Buildings and structures which contain materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following:

Corrosives

Highly toxic materials

Toxic materials

**High-hazard Group H-5.** Semiconductor fabrication facilities and comparable research and development areas in which hazardous production materials (HPM) are used and the aggregate quantity of materials is in excess of those listed in Tables 2A.7.7(1) and 2A.7.7(2). Such facilities and areas shall be designed and constructed in accordance with Section 2B.15.9.

**Institutional Group I.** Institutional Group I occupancy includes, among others, the use of a building or structure, or a portion thereof, in which people, cared for or living in a supervised environment and having physical limitations because of health or age, are harbored for medical treatment or other care or treatment, or in which people are detained for penal or correctional purposes or in which the liberty of the occupants is restricted. Institutional occupancies shall be classified as Group I-1, I-2, I-3 or I-4.

**Group I-1.** This occupancy shall include buildings, structures or parts thereof housing more than 16 persons, on a 24-hour basis, who because of age, mental disability or other reasons, live in a supervised residential environment that provides personal care services. The occupants are capable of responding to an emergency situation without physical assistance from staff. This group shall include, but not be limited to, the following:

Alcohol and drug centers  
 Assisted living facilities  
 Congregate care facilities  
 Convalescent facilities  
 Group homes  
 Half-way houses

Residential board and care facilities  
 Social rehabilitation facilities

A facility such as the above with five or fewer persons shall be classified as Group R-3. A facility such as above, housing at least six and not more than 16 persons, shall be classified as Group R-4.

**Group I-2.** This occupancy shall include buildings and structures used for medical, surgical, psychiatric, nursing or custodial care on a 24-hour basis of more than five persons who are not capable of self-preservation. This group shall include, but not be limited to, the following:

Hospitals  
 Nursing homes (both intermediate care facilities and skilled nursing facilities)  
 Mental hospitals  
 Detoxification facilities

A facility such as the above with five or fewer persons shall be classified as Group R-3.

A child care facility which provides care on a 24-hour basis to more than five children 2½ years of age or less shall be classified as Group I-2.

**Group I-3.** This occupancy shall include buildings and structures which are inhabited by more than five persons who are under restraint or security. An I-3 facility is occupied by persons who are generally incapable of self-preservation due to security measures not under the occupants' control. This group shall include, but not be limited to, the following:

Correctional centers  
 Detention centers  
 Jails  
 Prerelease centers  
 Prisons  
 Reformatories

Buildings of Group I-3 shall be classified as one of the occupancy conditions indicated in Sections 2A.8.4.1 through 2A.8.4.5 (see Section 2B.8.1).

**Condition 1.** This occupancy condition shall include buildings in which free movement is allowed from sleeping areas and other spaces where access or occupancy is permitted, to the exterior via means of egress without restraint. A Condition 1 facility is permitted to be constructed as Group R.

**Condition 2.** This occupancy condition shall include buildings in which free movement is allowed from sleeping areas and any other occupied smoke compartment to one or more other smoke compartments. Egress to the exterior is impeded by locked exits.

**Condition 3.** This occupancy condition shall include buildings in which free movement is allowed within individual smoke compartments, such as within a residential unit comprised of individual sleeping units and group activity spaces, where egress is impeded by remote-controlled release of means of egress from such smoke compartment to another smoke compartment.

**Condition 4.** This occupancy condition shall include buildings in which free movement is restricted from an occupied space. Remote-controlled release is

provided to permit movement from sleeping units, activity spaces and other occupied areas within the smoke compartment to other smoke compartments.

**Condition 5.** This occupancy condition shall include buildings in which free movement is restricted from an occupied space. Staff-controlled manual release is provided to permit movement from sleeping units, activity spaces and other occupied areas within the smoke compartment to other smoke compartments.

**Group I-4, day care facilities.** This group shall include buildings and structures occupied by persons of any age who receive custodial care for less than 24 hours by individuals other than parents or guardians, relatives by blood marriage, or adoption, and in a place other than the home of the person cared for. A facility such as the above with five or fewer persons shall be classified as Group R-3. Places of worship during religious functions are not included.

**Adult care facility.** A facility that provides accommodations for less than 24 hours for more than five unrelated adults and provides supervision and personal care services shall be classified as Group I-4.

**Exception:** Where the occupants are capable of responding to an emergency situation without physical assistance from the staff the facility shall be classified as Group A-3.

**Child care facility.** A facility that provides supervision and personal care on less than a 24-hour basis for more than five children 2<sup>1</sup>/<sub>2</sub> years of age or less shall be classified as Group I-4.

**Exception:** A child day care facility which provides care for more than five but no more than 100 children 2<sup>1</sup>/<sub>2</sub> years or less of age, when the rooms where such children are cared for are located on the level of exit discharge and each of these child care rooms has an exit door directly to the exterior, shall be classified as Group E.

**Mercantile Group M.** Mercantile Group M occupancy includes, among others, buildings and structures or a portion thereof, for the display and sale of merchandise, and involves stocks of goods, wares or merchandise incidental to such purposes and accessible to the public. Mercantile occupancies shall include, but not be limited to, the following:

Department stores

Drug stores

Markets

Motor fuel-dispensing facilities

Retail or wholesale stores

Sales rooms

**Residential Group R.** Residential Group R includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classed as Institutional Group I. Residential occupancies shall include the following:

**R-1** Residential occupancies where the occupants are primarily transient in nature including:

Boarding houses (transient)

Hotels (transient)

Motels (transient)

**R-2** Residential occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature, including:

Apartment houses

Boarding houses (not transient)

Dormitories

Fraternities and sororities

Hotels (nontransient)

Motels (nontransient)

Vacation timeshare properties

**R-3** Residential occupancies where the occupancies are primarily permanent in nature and not classified as R-1, R-2, or I and where buildings do not contain more than two dwelling units, or adult and child care facilities that provide accommodations for five or fewer persons of any age for less than 24-hours. Adult and child care facilities that are within a single-family home are permitted.

**R-4** Residential occupancies shall include buildings arranged for occupancy as Residential Care/Assisted Living Facilities including more than five but not more than 16 occupants.

Group R-4 occupancies shall meet the requirements for construction as defined for Group R-3 except for the height and area limitations provided in Section 3.3.

**Storage Group S.** Storage Group S occupancy includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.

**Moderate-hazard storage, Group S-1.** Buildings occupied for storage uses which are not classified as Group S-2 including, but not limited to, storage of the following:

Aerosols, Level 2 and 3

Aircraft repair hangar

Bags, cloth, burlap and paper

Bamboo and rattan

Baskets

Belting, canvas and leather

Books and paper in rolls or packs

Boots and shoes

Buttons, including cloth covered, pearl or bone

Cardboard and cardboard boxes

Clothing, woolen wearing apparel

Cordage

Furniture

Furs

Glue, mucilage, paste and size

Grain

Horn and combs, other than celluloid

Leather

Linoleum

Lumber

Motor vehicle repair garages (complying with the *International Building Code* and containing less than the maximum allowable quantities of hazardous materials)

Photo engraving

Resilient flooring

Silk

Soap

Sugar

Tires, bulk storage of

Tobacco, cigars, cigarettes and snuff

Upholstering and mattress

Wax candles

**Low-hazard storage, Group S-2.** Includes, among others, buildings used for the storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single thickness divisions; or in paper wrappings. Such products may have a negligible amount of plastic trim such as knobs, handles, or film wrapping. Storage uses shall include, but not be limited to, storage of the following:

Aircraft hangar

Asbestos

Cement in bags

Chalk and crayons

Dairy products in nonwaxed coated paper containers

Dry cell batteries

Electrical coils

Electrical motors

Empty cans

Food products

Foods in noncombustible containers

Fresh fruits and vegetables in nonplastic trays or containers

Frozen foods

Glass

Glass bottles, empty or filled with noncombustible liquids

Gypsum board

Inert pigments

Ivory

Metal desks with plastic tops and trim

Metal parts

Metals

Mirrors

Oil-filled and other types of distribution transformers

Parking garages (open or enclosed)

Porcelain and pottery

Stoves

Talc and soap stones

Washers and dryers

**Miscellaneous Group U.** Buildings and structures of an accessory character and miscellaneous structures not classified in any specific occupancy shall be constructed, equipped and maintained to conform to the requirements of the SBC commensurate with the fire and life hazard incidental to their occupancy.

Group U shall include, but not be limited to, the following:

Agricultural buildings

Aircraft hangar, accessory to a one- or two-family residence (see Section 2B.12.3)

Barns

Carports

Fences more than 1.83 m high

Grain silos, accessory to a residential occupancy

Greenhouses  
 Livestock shelters  
 Private garages  
 Retaining walls  
 Sheds  
 Stables  
 Tanks  
 Towers

**OCCUPANT LOAD.** See Section 8.2.1.

**OPEN BURNING.** See Section 5A.2.1.

**OPEN SYSTEM.** The use of a solid or liquid hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations. Examples of open systems for solids and liquids include dispensing from or into open beakers or containers, dip tank and plating tank operations.

**OPERATING BUILDING.** See Section 31.2.1.

**OPERATING PRESSURE.** The pressure at which a system operates.

**ORGANIC COATING.** See Section 18.2.1.

**ORGANIC PEROXIDE.** See Section 37.2.1.

**Class I.** See Section 37.2.1.

**Class II.** See Section 37.2.1.

**Class III.** See Section 37.2.1.

**Class IV.** See Section 37.2.1.

**Class V.** See Section 37.2.1.

**Unclassified detonable.** See Section 37.2.1.

**OUTDOOR CONTROL AREA.** See Section 25.2.1.

**OVERCROWDING.** A condition that exists when either there are more people in a building, structure or portion thereof than have been authorized or posted by the Building code official, or when the Building code official determines that a threat exist to the safety of the occupants due to persons sitting and/or standing in locations that may obstruct or impede the use of aisles, passages, corridors, stairways, exits or other components of the means of egress.

**OWNER.** A corporation, firm, partnership, association, organization and any other group acting as a unit, or a person who has legal title to any structure or premises with or without accompanying actual possession thereof, and shall include the duly authorized agent or attorney, a purchaser, devisee, fiduciary and any person having a vested or contingent interest in the premises in question.

**OXIDIZER.** See Section 38.2.1.

**Class 4.** See Section 38.2.1.

**Class 3.** See Section 38.2.1.

**Class 2.** See Section 38.2.1.

**Class 1.** See Section 38.2.1.

**OXIDIZING GAS.** See Section 38.2.1.

**OZONE-GAS GENERATOR.** See Section 35.2.1.

**PANIC HARDWARE.** See Section 8.2.1.

**PASS-THROUGH.** See Section 16.2.1.

**PERMISSIBLE EXPOSURE LIMIT (PEL).** See Section 25.2.1.

**PESTICIDE.** See Section 25.2.1.

**PHYSICAL HAZARD.** See Section 25.2.1.

**PLOSOPHORIC MATERIAL.** See Section 31.2.1.

**PLYWOOD and VENEER MILLS.** See Section 17.2.1.

**POWERED INDUSTRIAL TRUCK.** See Section 5A.2.1.

**PRESSURE VESSEL.** See Section 25.2.1.

**PRIMARY CONTAINMENT.** The first level of containment, consisting of the inside portion of that container which comes into immediate contact on its inner surface with the material being contained.

**PROCESS TRANSFER.** See Section 32.2.1.

**PROPELLANT.** See Section 26.2.1.

**PROXIMATE AUDIENCE.** See Section 31.2.1.

**PUBLIC WAY.** See Section 8.2.1.

**PYROPHORIC.** See Section 39.2.1.

**PYROTECHNIC COMPOSITION.** See Section 31.2.1.

**PYROTECHNIC SPECIAL EFFECT.** See Section 31.2.1.

**PYROTECHNIC SPECIAL-EFFECT MATERIAL.** See Section 31.2.1.

**RAILWAY.** See Section 31.2.1.

**RAMP.** See Section 8.2.1.

**RAW PRODUCT.** See Section 17.2.1.



**READY BOX.** See Section 31.2.1.

**RECORD DRAWINGS.** See Section 7.2.1.

**RECREATIONAL FIRE.** See Section 5A.2.1.

**REDUCED FLOW VALVE.** See Section 35.2.1.

**REFINERY.** See Section 32.2.1.

**REFRIGERANT.** See Section 5D.2.1.

**REFRIGERATION SYSTEM.** See Section 5D.2.1.

**REGISTERED DESIGN PROFESSIONAL.** An architect or engineer, registered or licensed to practice professional architecture or engineering, as defined by the statutory requirements of the professional registration laws of the state in which the project is to be constructed.

**REMOTE EMERGENCY SHUTOFF DEVICE.** See Section 32.2.1.

**REMOTE SOLVENT RESERVOIR.** See Section 32.2.1.

**REPAIR GARAGE.** See Section 20.2.1.

**RESIN APPLICATION AREA.** See Section 12.2.1.

**RESPONSIBLE PERSON.** See Section 24.2.1.

**RETAIL DISPLAY AREA.** See Section 26.2.1.

**ROLL COATING.** See Section 12.2.1.

**RUBBISH (TRASH).** Combustible and noncombustible waste materials, including residue from the burning of coal, wood, coke or other combustible material, paper, rags, cartons, tin cans, metals, mineral matter, glass crockery, dust and discarded refrigerators, and heating, cooking or incinerator-type appliances.

**SAFETY CAN.** See Section 25.2.1.

**SCISSOR STAIR.** See Section 8.2.1.

**SECONDARY CONTAINMENT.** See Section 25.2.1.

**SEGREGATED.** See Section 25.2.1.

**SELF-SERVICE MOTOR FUEL-DISPENSING FACILITY.** See Section 20.2.1.

**SEMICONDUCTOR FABRICATION FACILITY.** See Section 16.2.1.

**SERVICE CORRIDOR.** See Section 16.2.1.

**SHELF STORAGE.** See Section 21.2.1.

**SINGLE-STATION SMOKE ALARM.** See Section 7.2.1.

**SLEEPING UNIT.** See Section 7.2.1.

**SMALL ARMS AMMUNITION.** See Section 31.2.1.

**SMALL ARMS PRIMERS.** See Section 31.2.1.

**SMOKE ALARM.** See Section 7.2.1.

**SMOKE DETECTOR.** See Section 7.2.1.

**SMOKE-PROTECTED ASSEMBLY SEATING.** See Section 8.2.1.

**SMOKELESS PROPELLANTS.** See Section 31.2.1.

**SOLID.** See Section 25.2.1.

**SOLID SHELVING.** See Section 21.2.1.

**SOLVENT DISTILLATION UNIT.** See Section 32.2.1.

**SOLVENT OR LIQUID CLASSIFICATIONS.** See Section 13.2.1.

**Class I solvents.** See Section 13.2.1.

**Class II solvents.** See Section 13.2.1.

**Class IIIA solvents.** See Section 13.2.1.

**Class IIIB solvents.** See Section 13.2.1.

**Class IV solvents.** See Section 13.2.1.

**SPECIAL AMUSEMENT BUILDING.** A building that is temporary, permanent or mobile that contains a device or system that conveys passengers or provides a walkway along, around or over a course in any direction as a form of amusement arranged so that the egress path is not readily apparent due to visual or audio distractions or an intentionally confounded egress path, or is not readily available because of the mode of conveyance through the building or structure.

**SPECIAL INDUSTRIAL EXPLOSIVE DEVICE.** See Section 31.2.1.

**SPRAY AREA.** See Section 12.2.1.

**SPRAY BOOTH.** See Section 12.2.1.

**SPRAY ROOM.** See Section 12.2.1.

**STAIR.** See Section 8.2.1.

**STAIRWAY.** See Section 8.2.1.

**STAIRWAY, EXTERIOR.** See Section 8.2.1.

**STAIRWAY, INTERIOR.** See Section 8.2.1.

**STAIRWAY, SPIRAL.** See Section 8.2.1.

**STANDPIPE SYSTEM, CLASSES OF.** See Section 7.2.1.

**Class I system.** See Section 7.2.1.

**Class II system.** See Section 7.2.1.

**Class III system.** See Section 7.2.1.

**STANDPIPE, TYPES OF.** See Section 7.2.1.

**Automatic dry.** See Section 7.2.1.

**Automatic wet.** See Section 7.2.1.

**Manual dry.** See Section 7.2.1.

**Manual wet.** See Section 7.2.1.

**Semiautomatic dry.** See Section 7.2.1.

**STATIC PILES.** See Section 17.2.1.

**STEEL.** Hot- or cold-rolled as defined by the *Saudi Building Code*.

**STORAGE, HAZARDOUS MATERIALS.** See Section 25.2.1.

**STORY ABOVE GRADE PLANE.** Any story having its finished floor surface entirely above grade plane, except that a basement shall be considered as a story above grade plane where the finished surface of the floor above the basement is:

1. More than 1.8 m above grade plane;
2. More than 1.8 m above the finished ground level for more than 50 percent of the total building perimeter; or
3. More than 3.7 m above the finished ground level at any point.

**SUPERVISING STATION.** See Section 7.2.1.

**SUPERVISORY SERVICE.** See Section 7.2.1.

**SUPERVISORY SIGNAL.** See Section 7.2.1.

**SUPERVISORY SIGNAL-INITIATING DEVICE.** See Section 7.2.1.

**SYSTEM.** See Section 25.2.1.

**TANK.** A vessel containing more than 227 L.

**TANK, ATMOSPHERIC.** See Section 25.2.1.

**TANK, PORTABLE.** See Section 25.2.1.

**TANK, PRIMARY.** See Section 32.2.1.

**TANK, PROTECTED ABOVE GROUND.** See Section 32.2.1.

**TANK, STATIONARY.** See Section 25.2.1.

**TANK VEHICLE.** See Section 25.2.1.

**TENT.** See Section 22.2.1.

**THEFT RESISTANT.** See Section 31.2.1.

**THERMAL INSECTICIDAL FOGGING.** See Section 15.2.1.

**TIMBER AND LUMBER PRODUCTION FACILITIES.** See Section 17.2.1.

**TIRES, BULK STORAGE OF.** See Section 7.2.1.

**TOOL.** See Section 16.2.1.

**TORCH-APPLIED ROOF SYSTEM.** See Section 24.2.1.

**TOXIC.** See Section 35.2.1.

**TRANSVERSE FLUE SPACE.** See Section 21.2.1.

**TRASH.** See “Rubbish.”

**TROUBLE SIGNAL.** See Section 7.2.1.

**UNAUTHORIZED DISCHARGE.** See Section 25.2.1.

**UNSTABLE (REACTIVE) MATERIAL.** See Section 41.2.1.

**Class 4.** See Section 41.2.1.

**Class 3.** See Section 41.2.1.

**Class 2.** See Section 41.2.1.

**Class 1.** See Section 41.2.1.

**UNWANTED FIRE:** A fire not used for cooking, heating or recreational purposes or one not incidental to the normal operations of the property.

**USE (MATERIAL).** See Section 25.2.1.

**VALVE-REGULATED LEAD-ACID (VRLA) BATTERY:** See Section 5D.2.1.

**VAPOR AREA.** See Section 12.2.1.

**VAPOR PRESSURE.** See Section 25.2.1.

**VENTED (FLOODED) LEAD-ACID BATTERY.** See Section 5D.2.1.

**VISIBLE ALARM NOTIFICATION APPLIANCE.** See Section 7.2.1.

**WATER-REACTIVE MATERIAL.** See Section 42.2.1.

**Class 3.** See Section 42.2.1.

**Class 2.** See Section 42.2.1.

**Class 1.** See Section 42.2.1.

**WET-CHEMICAL EXTINGUISHING AGENT.** See Section 7.2.1.

**WINDER.** See Section 8.2.1.

**WIRELESS PROTECTION SYSTEM.** See Section 7.2.1.

**WORKSTATION.** See Section 16.2.1.

**ZONE.** See Section 7.2.1.

## CHAPTER 2

### USE AND OCCUPANCY CLASSIFICATION AND SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

#### SECTION 2A

#### USE AND OCCUPANCY CLASSIFICATION

##### SECTION 2A.1

##### GENERAL

- 2A.1.1 Scope.** The provisions of this chapter shall control the classification of all buildings and structures as to use and occupancy.

##### SECTION 2A.2

##### CLASSIFICATION

- 2A.2.1 General.** Structures or portions of structures shall be classified with respect to occupancy in one or more of the groups listed below. Structures with multiple uses shall be classified according to Section 2A.2.3. Where a structure is proposed for a purpose which is not specifically provided for in SBC 201, such structure shall be classified in the group which the occupancy most nearly resembles, according to the fire safety and relative hazard involved.

1. Assembly (see Section 2A.3): Groups A-1, A-2, A-3, A-4 and A-5
2. Business (see Section 2A.4): Group B
3. Educational (see Section 2A.5): Group E
4. Factory and Industrial (see Section 2A.6): Groups F-1 and F-2
5. High Hazard (see Section 2A.7): Groups H-1, H-2, H-3, H-4 and H-5
6. Institutional (see Section 2A.8): Groups I-1, I-2, I-3 and I-4
7. Mercantile (see Section 2A.9): Group M
8. Residential (see Section 2A.10): Groups R-1, R-2, R-3 as applicable in Section 101.2, and R-4
9. Storage (see Section 2A.11): Groups S-1 and S-2
10. Utility and Miscellaneous (see Section 2A.12): Group U

- 2A.2.1.1 Incidental use areas.** Spaces which are incidental to the main occupancy shall be separated or protected, or both, in accordance with Table 2A.2.1.1 or the building shall be classified as a mixed occupancy and comply with Section 2A.2.3. Areas that are incidental to the main occupancy shall be classified in accordance with the main occupancy of the portion of the building in which the incidental use area is located.

**Exception:** Incidental use areas within and serving a dwelling unit are not required to comply with this section.

- 2A.2.1.1.1 Separation.** Where Table 2A.2.1.1 requires a fire-resistance-rated separation, the incidental use area shall be separated from the remainder of the building with a fire barrier. Where Table 2A.2.1.1 permits an automatic fire-extinguishing system without a fire barrier, the incidental use area shall be separated by construction capable of resisting the passage of smoke. The partitions shall extend from the floor to the underside of the fire-resistance-rated floor/ceiling assembly or fire-resistance-rated roof/ceiling assembly or to the underside of the floor or roof deck above. Doors shall be self-closing or automatic-closing upon detection of smoke. Doors shall not have air transfer openings and shall not be undercut in excess of the clearance permitted in accordance with NFPA 80.

**2A.2.2 Accessory use areas.** A fire barrier shall be required to separate accessory use areas classified as Group H in accordance with Section 2A.2.3.1, and incidental use areas in accordance with Section 2A.2.1.1. Any other accessory use area shall not be required to be separated by a fire barrier provided the accessory use area occupies an area not more than 10 percent of the area of the story in which it is located and does not exceed the tabular values in Table 5C.3 for the allowable height or area for such use.

**2A.2.2.1 Assembly areas.** Accessory assembly areas are not considered separate occupancies if the floor area is equal to or less than 70 m<sup>2</sup>. Assembly areas that are accessory to Group E are not considered separate occupancies. Accessory educational rooms, multi-purpose halls and auditoriums with occupant loads of less than 100 are not considered separate occupancies.

**TABLE 2A.2.1.1  
INCIDENTAL USE AREAS**

ROOM OR AREA	SEPARATION <sup>a</sup>
Furnace room where any piece of equipment is over 117 kW per hour input	1 hour or provide automatic fire-extinguishing system
Rooms with any boiler over 103.5 kPa and 7.5 kW	1 hour or provide automatic fire-extinguishing system
Refrigerant machinery rooms	1 hour or provide automatic sprinkler system
Parking garage (Section 2B.6.2)	2 hours; or 1 hour and provide automatic fire-extinguishing system
Hydrogen cut-off rooms	1 hour fire barriers and floor/ceiling assemblies in Group B, F, H, M, S and U occupancies. 2 hours fire barriers and floor/ceiling assemblies in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic fire-extinguishing system
Laboratories and vocational shops, not classified as Group H, located in Group E or I-2 occupancies	1 hour or provide automatic fire-extinguishing system
Laundry rooms over 9 m <sup>2</sup>	1 hour or provide automatic fire-extinguishing system
Storage rooms over 9 m <sup>2</sup>	1 hour or provide automatic fire-extinguishing system
Group I-3 cells equipped with padded surfaces	1 hour
Group I-2 waste and linen collection rooms	1 hour
Waste and linen collection rooms over 9 m <sup>2</sup>	1 hour or provide automatic fire-extinguishing system
Stationary lead-acid battery systems having a liquid capacity of more than 379 liters used for facility standby power, emergency power or uninterrupted power supplies	1 hour fire barriers and floor/ceiling assemblies in Group B, F, H, M, S and U occupancies. 2 hours fire barriers and floor/ceiling assemblies in Group A, E, I and R occupancies

a. Where an automatic fire-extinguishing system is provided, it need only be provided in the incidental use room or area.

**2A.2.3 Mixed occupancies.** Where a building is occupied by two or more uses not included in the same occupancy classification, the building or portion thereof shall comply with Section 2A.2.3.1 or 2A.2.3.2 or a combination of these sections.

**Exceptions:**

1. Occupancies separated in accordance with Section 5C.8.
2. Areas of Group H-2, H-3, H-4 or H-5 occupancies shall be separated from any other occupancy in accordance with Section 2A.2.3.2.
3. Where required by Table 2B.15.3.2, areas of Group H-1, H-2 or H-3 occupancy shall be located in a separate and detached building or structure.
4. Accessory use areas in accordance with Section 2A.2.2.
5. Incidental use areas in accordance with Section 2A.2.1.1.

- 2A.2.3.1 Non-separated uses.** Each portion of the building shall be individually classified as to use. The required type of construction for the building shall be determined by applying the height and area limitations for each of the applicable occupancies to the entire building. The most restrictive type of construction, so determined, shall apply to the entire building. All other code requirements shall apply to each portion of the building based on the use of that space except that the most restrictive applicable provisions of Section 2B.3 and Chapter 7 shall apply to these non-separated uses. Fire separations are not required between uses, except as required by other provisions.
- 2A.2.3.2 Separated uses.** Each portion of the building shall be individually classified as to use and shall be completely separated from adjacent areas by fire barrier walls or horizontal assemblies or both having a fire-resistance rating determined in accordance with Table 2A.2.3.2 for uses being separated. Each fire area shall comply with these code requirements based on the use of that space. Each fire area shall comply with the height limitations based on the use of that space and the type of construction classification. In each story, the building area shall be such that the sum of the ratios of the floor area of each use divided by the allowable area for each use shall not exceed one.
- Exception:** Except for Group H and I-2 areas, where the building is equipped throughout with an automatic sprinkler system, installed in accordance with Section 7.3.3.1.1, the fire-resistance ratings in Table 2A.2.3.3 shall be reduced by 1 hour but to not less than 1 hour and to not less than that required for floor construction according to the type of construction.
- 2A.2.4 Spaces used for different purposes.** A room or space that is intended to be occupied at different times for different purposes shall comply with all the requirements that are applicable to each of the purposes for which the room or space will be occupied.

### SECTION 2A.3 ASSEMBLY GROUP A

- 2A.3.1 Assembly Group A.** Assembly Group A occupancy includes, among others, the use of a building or structure, or a portion thereof, for the gathering together of persons for purposes such as civic, social or religious functions, recreation, food or drink consumption or awaiting transportation. A room or space used for assembly purposes by less than 50 persons and accessory to another occupancy shall be included as a part of that occupancy. Assembly areas with less than 70 m<sup>2</sup> and which are accessory to another occupancy according to Section 2A.2.2.1 are not assembly occupancies. Assembly occupancies which are accessory to Group E in accordance with Section 2A.2.2 are not considered assembly occupancies. Educational rooms, multi-purpose halls and auditoriums which are accessory to mosques in accordance with Section 2A.2.2 and which have occupant loads of less than 100 shall be classified as A-3.
- Assembly occupancies shall include the following:
- A-1** Assembly uses, usually with fixed seating, intended for the production and viewing of the performing arts or motion pictures including, but not limited to:
    - Motion picture theaters
    - Symphony and concert halls
    - Television and radio studios admitting an audience
    - Theaters



**TABLE 2A.2.3.2  
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)<sup>a</sup>**

USE	A-1	A-2	A-3	A-4	A-5	B <sup>b</sup>	E	F-1	F-2	H-1	H-2	H-3	H-4	H-5	I-1	I-2	I-3	I-4	M <sup>b</sup>	R-1	R-2	R-3, R-4	S-1	S-2 <sup>c</sup>	U
A-1	---	2	2	2	2	2	2	3	2	NP	4	3	2	4	2	2	2	2	2	2	2	2	3	2	1
A-2 <sup>e</sup>	---	---	2	2	2	2	2	3	2	NP	4	3	2	4	2	2	2	2	2	2	2	2	3	2	1
A-3	---	---	---	2	2	2	2	3	2	NP	4	3	2	4	2	2	2	2	2	2	2	2	3	2	1
A-4	---	---	---	---	2	2	2	3	2	NP	4	3	2	4	2	2	2	2	2	2	2	2	3	2	1
A-5	---	---	---	---	---	2	2	3	2	NP	4	3	2	4	2	2	2	2	2	2	2	2	3	2	1
B <sup>b</sup>	---	---	---	---	---	---	2	3	2	NP	2	1	1	1	2	2	2	2	2	2	2	2	3	2	1
E	---	---	---	---	---	---	---	3	2	NP	4	3	2	3	2	2	2	2	2	2	2	2	3	2	1
F-1	---	---	---	---	---	---	---	---	3	NP	2	1	1	1	3	3	3	3	3	3	3	3	3	3	3
F-2	---	---	---	---	---	---	---	---	---	NP	2	1	1	1	2	2	2	2	2	2	2	2	3	2	1
H-1	---	---	---	---	---	---	---	---	---	---	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
H-2	---	---	---	---	---	---	---	---	---	---	---	1	2	2	4	4	4	4	4	2	4	4	2	2	1
H-3	---	---	---	---	---	---	---	---	---	---	---	---	1	1	4	3	3	3	1	3	3	3	1	1	1
H-4	---	---	---	---	---	---	---	---	---	---	---	---	---	1	4	4	4	4	1	4	4	4	1	1	1
H-5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4	4	4	3	1	4	4	4	1	1	3
I-1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	2	2	2	2	2	4	3	2
I-2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	2	2	2	2	2	3	2	1
I-3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	2	2	2	2	3	2	1
I-4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	2	2	3	2	1
M <sup>b</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	---	2	2	3	2	1
R-1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	2	3	2	1
R-2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2	2	2	3	2	1
R3, R-4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	2 <sup>d</sup>	1 <sup>d</sup>
S-1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3	3
S-2 <sup>c</sup>	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1
U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

NP = Not permitted.

- See Exception 1 to Section 2A.2.3.2 for reductions permitted.
- Occupancy separation need not be provided for storage areas within Groups B and M if the:
  - Area is less than 10 percent of the floor area;
  - Area is provided with an automatic fire-extinguishing system and is less than 279 m<sup>2</sup>; or
  - Area is less than 93 m<sup>2</sup>.
- Areas used only for private or pleasure vehicles shall be allowed to reduce separation by 1 hour.
- See exception to Section 2A.2.3.2.
- Commercial kitchens need not be separated from the restaurant seating areas that they serve.

**A-2** Assembly uses intended for food and/or drink consumption including, but not limited to:

Banquet halls  
Restaurants  
Cafes

**A-3** Assembly uses intended for worship, recreation or amusement and other assembly uses not classified elsewhere in Group A including, but not limited to:

Amusement arcades  
Art galleries  
Bowling alleys  
Mosques  
Community halls  
Courtrooms  
Dance halls (not including food or drink consumption)  
Exhibition halls  
Funeral centers  
Gymnasiums (without spectator seating)  
Indoor swimming pools (without spectator seating)  
Indoor tennis courts (without spectator seating)  
Lecture halls  
Libraries  
Museums  
Waiting areas in transportation terminals  
Pool and billiard parlors

**A-4** Assembly uses intended for viewing of indoor sporting events and activities with spectator seating including, but not limited to:

Arenas  
Skating rinks  
Swimming pools  
Tennis courts

**A-5** Assembly uses intended for participation in or viewing outdoor activities including, but not limited to:

Amusement park structures  
Bleachers  
Grandstands  
Stadiums

**2A.3.1.1 Non-accessory assembly use.** A building or tenant space used for assembly purposes by less than 50 persons shall be considered a Group B occupancy.

## **SECTION 2A.4 BUSINESS GROUP B**

**2A.4.1 Business Group B.** Business Group B occupancy includes, among others, the use of a building or structure, or a portion thereof, for office, professional or service-type transactions, including storage of records and accounts. Business occupancies shall include, but not be limited to, the following:

Airport traffic control towers  
Animal hospitals, kennels and pounds  
Banks  
Barber and beauty shops  
Car wash  
Civic administration

Clinic – outpatient  
 Dry cleaning and laundries; pick-up and delivery stations and self-service  
 Educational occupancies above the 12<sup>th</sup> grade for male/female  
 Electronic data processing  
 Laboratories; testing and research  
 Motor vehicle showrooms  
 Post offices  
 Print shops  
 Professional services (architects, attorneys, dentists, physicians, engineers, etc.)  
 Radio and television stations  
 Telephone exchanges

## SECTION 2A.5 EDUCATIONAL GROUP E

- 2A.5.1 Educational Group E.** Educational Group E occupancy includes, among others, the use of a building or structure, or a portion thereof, by six or more persons at any one time for educational purposes through the 12<sup>th</sup> grade. Educational rooms, multi-purpose halls and auditoriums, which are accessory to mosques in accordance with Section 2A.2.2 and have occupant loads of less than 100, shall be classified as A-3 occupancies.
- 2A.5.2 Day care.** The use of a building or structure, or portion thereof, for educational, supervision or personal care services for more than five children older than 2<sup>1</sup>/<sub>2</sub> years of age, shall be classified as a Group E occupancy.

## SECTION 2A.6 FACTORY GROUP F

- 2A.6.1 Factory Industrial Group F.** Factory Industrial Group F occupancy includes, among others, the use of a building or structure, or a portion thereof, for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repair or processing operations that are not classified as a Group H hazardous or Group S storage occupancy.
- 2A.6.2 Factory Industrial F-1 Moderate-Hazard Occupancy.** Factory industrial uses which are not classified as Factory Industrial F-2 Low Hazard shall be classified as F-1 Moderate Hazard and shall include, but not be limited to, the following:
- Aircraft
  - Appliances
  - Athletic equipment
  - Automobiles and other motor vehicles
  - Bakeries
  - Medical products over 12-percent alcohol content
  - Bicycles
  - Boats
  - Brooms or brushes
  - Business machines
  - Cameras and photo equipment
  - Canvas or similar fabric
  - Carpets and rugs (includes cleaning)
  - Clothing

Construction and agricultural machinery  
 Disinfectants  
 Dry cleaning and dyeing  
 Electric generation plants  
 Electronics  
 Engines (including rebuilding)  
 Food processing  
 Furniture  
 Hemp products  
 Jute products  
 Laundries  
 Leather products  
 Machinery  
 Metals  
 Millwork (sash & door)  
 Motion pictures and television filming (without spectators)  
 Musical instruments  
 Optical goods  
 Paper mills or products  
 Photographic film  
 Plastic products  
 Printing or publishing  
 Recreational vehicles  
 Refuse incineration  
 Shoes  
 Soaps and detergents  
 Textiles  
 Tobacco  
 Trailers  
 Upholstering  
 Wood; distillation  
 Woodworking (cabinet)

**2A.6.3 Factory Industrial F-2 Low-Hazard Occupancy.** Factory industrial uses that involve the fabrication or manufacturing of noncombustible materials which during finishing, packing or processing do not involve a significant fire hazard shall be classified as F-2 occupancies and shall include, but not be limited to, the following:

Medical products; up to and including 12-percent alcohol content  
 Brick and masonry  
 Ceramic products  
 Foundries  
 Glass products  
 Gypsum  
 Ice  
 Metal products (fabrication and assembly)

## SECTION 2A.7 HIGH-HAZARD GROUP H

**2A.7.1 High-Hazard Group H.** High-Hazard Group H occupancy includes, among others, the use of a building or structure, or a portion thereof, that involves the

manufacturing, processing, generation or storage of materials that constitute a physical or health hazard in quantities in excess of those found in Tables 5A.7.7(1) and 5A.7.7(2) (see also definition of “Control area”).

**2A.7.2 Definitions.** The following words and terms shall, for the purposes of this section and as used elsewhere in these code requirements, have the meanings shown herein.

**AEROSOL.** A product that is dispensed from an aerosol container by a propellant. Aerosol products shall be classified by means of the calculation of their chemical heats of combustion and shall be designated Level 1, 2 or 3.

**Level 1 aerosol products.** Those with a total chemical heat of combustion that is less than or equal to 20 kJ/g.

**Level 2 aerosol products.** Those with a total chemical heat of combustion that is greater than 20 kJ/g, but less than or equal to 30 kJ/g.

**Level 3 aerosol products.** Those with a total chemical heat combustion that is greater than 30 kJ/g.

**AEROSOL CONTAINER.** A metal can or a glass or plastic bottle designed to dispense an aerosol. Metal cans shall be limited to a maximum size of 1,000 ml. Glass or plastic bottles shall be limited to a maximum size of 118 ml.

**BARRICADE.** A structure that consists of a combination of walls, floor and roof, which is designed to withstand the rapid release of energy in an explosion and which is fully confined, partially vented or fully vented; or other effective method of shielding from explosive materials by a natural or artificial barrier.

**Artificial barricade.** An artificial mound or revetment a minimum thickness of 914 mm.

**Natural barricade.** Natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures that require protection cannot be seen from the magazine or building containing explosives when the trees are bare of leaves.

**BOILING POINT.** The temperature at which the vapor pressure of a liquid equals the atmospheric pressure of 101 kPa gage or 760 mm of mercury. Where an accurate boiling point is unavailable for the material in question, or for mixtures, which do not have a constant boiling point, for the purposes of this classification, the 20-percent evaporated point of a distillation performed in accordance with ASTM D 86, shall be used as the boiling point of the liquid.

**CLOSED SYSTEM.** The use of a solid or liquid hazardous material involving a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases. Examples of closed systems for solids and liquids include product conveyed through a piping system into a closed vessel, system or piece of equipment.

**COMBUSTIBLE DUST.** Finely divided solid material that is 420 microns or less in diameter and which, when dispersed in air in the proper proportions, could be ignited by a flame, spark or other source of ignition. Combustible dust will pass through a U.S. No. 40 standard sieve.

**COMBUSTIBLE FIBERS.** Readily ignitable and free-burning fibers, such as cocoa fiber, cloth, cotton, excelsior, hay, hemp, henequen, istle, jute, kapok, oakum, rags, sisal, Spanish moss, straw, tow, wastepaper or other like materials.

**COMBUSTIBLE LIQUID.** A liquid having a closed cup flash point at or above 38°C. Combustible liquids shall be subdivided as follows:

**Class II.** Liquids having a closed cup flash point at or above 38°C and below 60°C.

**Class IIIA.** Liquids having a closed cup flash point at or above 60°C and below 93°C.

**Class IIIB.** Liquids having a closed cup flash point at or above 93°C.

The category of combustible liquids does not include compressed gases or cryogenic fluids.

**COMPRESSED GAS.** A material, or mixture of materials which:

1. Is a gas at 20°C or less at 101 kPa of pressure; and
2. Has a boiling point of 20°C or less at 101 kPa which is either liquefied, non-liquefied or in solution, except those gases which have no other health or physical-hazard properties are not considered to be compressed until the pressure in the packaging exceeds 282 kPa at 20°C.

The states of a compressed gas are categorized as follows:

1. Non-liquefied compressed gases are gases, other than those in solution, which are in a packaging under the charged pressure and are entirely gaseous at a temperature of 20°C.
2. Liquefied compressed gases are gases that, in a packaging under the charged pressure, are partially liquid at a temperature of 20°C.
3. Compressed gases in solution are non-liquefied gases that are dissolved in a solvent.
4. Compressed gas mixtures consist of a mixture of two or more compressed gases contained in a packaging, the hazard properties of which are represented by the properties of the mixture as a whole.

**CONTROL AREA.** Spaces within a building that are enclosed and bounded by exterior walls, fire walls, fire barriers and roofs, or a combination thereof, where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled.

**CORROSIVE.** A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. A chemical shall be considered corrosive if, when tested on the intact skin of albino rabbits by the method described in DOTn 49 CFR, Part 173.137, such a chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of 4 hours. This term does not refer to action on inanimate surfaces.

**CRYOGENIC FLUID.** A liquid having a boiling point lower than 101°C at an absolute pressure of 101 kPa.

**DEFLAGRATION.** An exothermic reaction, such as the extremely rapid oxidation of a flammable dust or vapor in air, in which the reaction progresses through the unburned material at a rate less than the velocity of sound. A

deflagration can have an explosive effect.

**DETACHED BUILDING.** A separate single-story building, without a basement or crawl space, used for the storage or use of hazardous materials and located an approved distance from all structures.

**DETONATION.** An exothermic reaction characterized by the presence of a shock wave in the material which establishes and maintains the reaction. The reaction zone progresses through the material at a rate greater than the velocity of sound. The principal heating mechanism is one of shock compression. Detonations have an explosive effect.

**DISPENSING.** The pouring or transferring of any material from a container, tank or similar vessel, whereby vapors, dusts, fumes, mists or gases are liberated to the atmosphere.

**EXPLOSIVE.** Any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion. The term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, igniters and display fireworks, 1.3G (Class B, Special). The term “explosive” includes any material determined to be within the scope of USC Title 18: Chapter 40 and also includes any material classified as an explosive other than consumer fireworks, 1.4G (Class C, Common) by the hazardous materials regulations of DOTn 49 CFR.

**High explosive.** Explosive material, such as dynamite, which can be caused to detonate by means of a No. 8 test blasting cap when unconfined.

**Low explosive.** Explosive material that will burn or deflagrate when ignited. It is characterized by a rate of reaction that is less than the speed of sound. Examples of low explosives include, but are not limited to, black powder; safety fuse; igniters; igniter cord; fuse lighters; fireworks, 1.3G (Class B, Special) and propellants, 1.3C.

**Mass-detonating explosives.** Divisions 1.1, 1.2 and 1.5 explosives alone or in combination, or loaded into various types of ammunition or containers, most of which can be expected to explode virtually instantaneously when a small portion is subjected to fire, severe concussion, impact, the impulse of an initiating agent or the effect of a considerable discharge of energy from without. Materials that react in this manner represent a mass explosion hazard. Such an explosive will normally cause severe structural damage to adjacent objects. Explosive propagation could occur immediately to other items of ammunition and explosives stored sufficiently close to and not adequately protected from the initially exploding pile with a time interval short enough so that two or more quantities must be considered as one for quantity-distance purposes.

**MOI (UN/DOTn) Class 1 explosive.** The former classification system used by DOTn included the terms “high” and “low” explosives as defined herein. The following terms further define explosives under the current system applied by (DOTn for all explosive materials defined as hazard Class 1 materials). Compatibility group letters are used in concert with the division to specify further limitations on each division noted (i.e., the letter G identifies the material as a pyrotechnic substance or article containing a pyrotechnic substance and similar materials).



**Division 1.1.** Explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.

**Division 1.2.** Explosives that have a projection hazard but not a mass explosion hazard.

**Division 1.3.** Explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

**Division 1.4.** Explosives that pose a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

**Division 1.5.** Very insensitive explosives. This division is comprised of substances that have a mass explosion hazard, but that are so insensitive there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

**Division 1.6.** Extremely insensitive articles which do not have a mass explosion hazard. This division is comprised of articles that contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

**FIREWORKS.** Any composition or device for the purpose of producing a visible or audible effect for entertainment purposes by combustion, deflagration or detonation that meets the definition of 1.4G fireworks or 1.3G fireworks as set forth herein.

**FIREWORKS, 1.3G.** (Formerly Class B, Special Fireworks.) Large fireworks devices, which are explosive materials, intended for use in fireworks displays and designed to produce audible or visible effects by combustion, deflagration or detonation. Such 1.3G fireworks include, but are not limited to, firecrackers containing more than 130 milligrams (2 grains) of explosive composition, aerial shells containing more than 40 grams of pyrotechnic composition, and other display pieces which exceed the limits for classification as 1.4G fireworks. Such 1.3G fireworks are also described as fireworks, 49 CFR (172) by the DOTn.

**FIREWORKS, 1.4G.** (Formerly Class C, Common Fireworks.) Small fireworks devices containing restricted amounts of pyrotechnic composition designed primarily to produce visible or audible effects by combustion. Such 1.4G fireworks which comply with the construction, chemical composition and labeling regulations of the DOTn, 49 CFR (172) for fireworks, and the local Consumer Product Safety Commission (CPSC) as set forth in CPSC 16 CFR: Parts 1500 and 1507 are not explosive materials for the purpose of these code requirements.

**FLAMMABLE GAS.** A material that is a gas at 20°C or less at 101 kPa of pressure [a material that has a boiling point of 20°C or less at 101 kPa)] which:

1. Is ignitable at 101 kPa when in a mixture of 13 percent or less by volume with air; or
2. Has a flammable range at 101 kPa with air of at least 12 percent, regardless of the lower limit.

The limits specified shall be determined at 101 kPa of pressure and a temperature of 20°C in accordance with (ASTM E 681).

**FLAMMABLE LIQUEFIED GAS.** A liquefied compressed gas which, under a charged pressure, is partially liquid at a temperature of 20°C and which is



flammable.

**FLAMMABLE LIQUID.** A liquid having a closed cup flash point below 38°C. Flammable liquids are further categorized into a group known as Class I liquids. The Class I category is subdivided as follows:

**Class IA.** Liquids having a flash point below 23°C and a boiling point below 38°C.

**Class IB.** Liquids having a flash point below 23°C and a boiling point at or above 38°C.

**Class IC.** Liquids having a flash point at or above 23°C and below 38°C.

The category of flammable liquids does not include compressed gases or cryogenic fluids.

**FLAMMABLE MATERIAL.** A material capable of being readily ignited from common sources of heat or at a temperature of 316°C or less.

**FLAMMABLE SOLID.** A solid, other than a blasting agent or explosive, that is capable of causing fire through friction, absorption or moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which has an ignition temperature below 100°C or which burns so vigorously and persistently when ignited as to create a serious hazard. A chemical shall be considered a flammable solid as determined in accordance with the test method of CPSC 16 CFR; Part 1500.44, if it ignites and burns with a self-sustained flame at a rate greater than 2.5 mm per second along its major axis.

**FLASH POINT.** The minimum temperature in degrees Fahrenheit at which a liquid will give off sufficient vapors to form an ignitable mixture with air near the surface or in the container, but will not sustain combustion. The flash point of a liquid shall be determined by appropriate test procedure and apparatus as specified in ASTM D 56, ASTM D 93 or ASTM D 3278.

**HANDLING.** The deliberate transport by any means to a point of storage or use.

**HAZARDOUS MATERIALS.** Those chemicals or substances that are physical hazards or health hazards as defined and classified in this section and these code requirements, whether the materials are in usable or waste condition.

**HEALTH HAZARD.** A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term “health hazard” includes chemicals that are toxic or highly toxic, and corrosive.

**HIGHLY TOXIC.** A material which produces a lethal dose or lethal concentration that falls within any of the following categories:

1. A chemical that has a median lethal dose (LD<sub>50</sub>) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD<sub>50</sub>) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC<sub>50</sub>) in air of 200 parts

per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

Mixtures of these materials with ordinary materials, such as water, might not warrant classification as highly toxic. While this system is basically simple in application, any hazard evaluation that is required for the precise categorization of this type of material shall be performed by experienced, technically competent persons.

**INCOMPATIBLE MATERIALS.** Materials that, when mixed, have the potential to react in a manner that generates heat, fumes, gases or by-products which are hazardous to life or property.

**OPEN SYSTEM.** The use of a solid or liquid hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations. Examples of open systems for solids and liquids include dispensing from or into open beakers or containers, dip tank and plating tank operations.

**OPERATING BUILDING.** A building occupied in conjunction with the manufacture, transportation or use of explosive materials. Operating buildings are separated from one another with the use of intraplant or intraline distances.

**ORGANIC PEROXIDE.** An organic compound that contains the bivalent structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radical. Organic peroxides can pose an explosion hazard (detonation or deflagration) or they can be shock sensitive. They can also decompose into various unstable compounds over an extended period of time.

**Class I.** Those formulations that are capable of deflagration but not detonation.

**Class II.** Those formulations that burn very rapidly and that pose a moderate reactivity hazard.

**Class III.** Those formulations that burn rapidly and that pose a moderate reactivity hazard.

**Class IV.** Those formulations that burn in the same manner as ordinary combustibles and that pose a minimal reactivity hazard.

**Class V.** Those formulations that burn with less intensity than ordinary combustibles or do not sustain combustion and that pose no reactivity hazard.

**Unclassified detonable.** Organic peroxides that are capable of detonation. These peroxides pose an extremely high explosion hazard through rapid explosive decomposition.

**OXIDIZER.** A material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials. Examples of other oxidizing gases include bromine, chlorine and fluorine.

**Class 4.** An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. Additionally, the oxidizer will enhance the burning rate and can cause spontaneous ignition of combustibles.

**Class 3.** An oxidizer that will cause a severe increase in the burning rate of

combustible materials with which it comes in contact or that will undergo vigorous self-sustained decomposition due to contamination or exposure to heat.

**Class 2.** An oxidizer that will cause a moderate increase in the burning rate or that causes spontaneous ignition of combustible materials with which it comes in contact.

**Class 1.** An oxidizer whose primary hazard is that it slightly increases the burning rate but which does not cause spontaneous ignition when it comes in contact with combustible materials.

**OXIDIZING GAS.** A gas that can support and accelerate combustion of other materials.

**PHYSICAL HAZARD.** A chemical for which there is evidence that it is a combustible liquid, compressed gas, cryogenic, explosive, flammable gas, flammable liquid, flammable solid, organic peroxide, oxidizer, pyrophoric or unstable (reactive) or water-reactive material.

**PYROPHORIC.** A chemical with an auto-ignition temperature in air, at or below a temperature of 54°C.

**PYROTECHNIC COMPOSITION.** A chemical mixture that produces visible light displays or sounds through a self-propagating, heat-releasing chemical reaction which is initiated by ignition.

**TOXIC.** A chemical falling within any of the following categories:

1. A chemical that has a median lethal dose (LD<sub>50</sub>) of more than 50 milligrams per kilogram, but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD<sub>50</sub>) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC<sub>50</sub>) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

**UNSTABLE (REACTIVE) MATERIAL.** A material, other than an explosive, which in the pure state or as commercially produced, will vigorously polymerize, decompose, condense or become self-reactive and undergo other violent chemical changes, including explosion, when exposed to heat, friction or shock, or in the absence of an inhibitor, or in the presence of contaminants, or in contact with incompatible materials. Unstable (reactive) materials are subdivided as follows:

**Class 4.** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This class includes materials that are sensitive to mechanical or localized thermal shock at normal temperatures and pressures.

**Class 3.** Materials that in themselves are capable of detonation or of explosive decomposition or explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. This class includes materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

**Class 2.** Materials that in themselves are normally unstable and readily undergo violent chemical change but do not detonate. This class includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures, and that can undergo violent chemical change at elevated temperatures and pressures.

**Class 1.** Materials that in themselves are normally stable but which can become unstable at elevated temperatures and pressure.

**WATER-REACTIVE MATERIAL.** A material that explodes; violently reacts; produces flammable, toxic or other hazardous gases; or evolves enough heat to cause self-ignition or ignition of nearby combustibles upon exposure to water or moisture. Water-reactive materials are subdivided as follows:

**Class 3.** Materials that react explosively with water without requiring heat or confinement.

**Class 2.** Materials that may form potentially explosive mixtures with water.

**Class 1.** Materials that may react with water with some release of energy, but not violently.

**2A.7.3 High-Hazard Group H-1.** Buildings and structures which contain materials that present a detonation hazard shall be classified as Group H-1. Such materials shall include, but not be limited to, the following:

Explosives:

Division 1.1

Division 1.2

Division 1.3

**Exception:** Materials that are used and maintained in a form where either confinement or configuration will not elevate the hazard from a mass fire to mass explosion hazard shall be allowed in H-2 occupancies.

Division 1.4

**Exception:** Articles, including articles packaged for shipment, that are not regulated as an explosive under Bureau of Alcohol, Tobacco and Firearms regulations, or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles shall be allowed in H-3 occupancies.

Division 1.5

Division 1.6

Organic peroxides, unclassified detonable

Oxidizers, Class 4

Unstable (reactive) materials, Class 3 detonable, and Class 4

Detonable pyrophoric materials

**2A.7.4 High-Hazard Group H-2.** Buildings and structures which contain materials that present a deflagration hazard or a hazard from accelerated burning shall be classified as Group H-2. Such materials shall include, but not be limited to, the following:

Class I, II or IIIA flammable or combustible liquids which are used or stored in normally open containers or systems, or in closed containers or systems

pressurized at more than 103.4 kPa gage

Combustible dusts

Cryogenic fluids, flammable

Flammable gases

Organic peroxides, Class I

Oxidizers, Class 3, that are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 1,03.3 kPa gage

Pyrophoric liquids, solids and gases, non-detonable

Unstable (reactive) materials, Class 3, non-detonable

Water-reactive materials, Class 3

- 2A.7.5 High-Hazard Group H-3.** Buildings and structures that contain materials that readily support combustion or present a physical hazard shall be classified as Group H-3. Such materials shall include, but not be limited to, the following:  
 Class I, II or IIIA flammable or combustible liquids which are used or stored in normally closed containers or systems pressurized at less than 103 kPa gage  
 Combustible fibers  
 Consumer fireworks, 1.4G (Class C, Common)  
 Cryogenic fluids, oxidizing  
 Flammable solids  
 Organic peroxides, Classes II and III  
 Oxidizers, Classes 1 and 2  
 Oxidizing gases  
 Unstable (reactive) materials, Class 2  
 Water-reactive materials, Class 2
- 2A.7.6 High-Hazard Group H-4.** Buildings and structures which contain materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following:  
 Corrosives  
 Highly toxic materials  
 Toxic materials
- 2A.7.7 Group H-5 structures.** Semiconductor fabrication facilities and comparable research and development areas in which hazardous production materials (HPM) are used and the aggregate quantity of materials is in excess of those listed in Tables 2A.7.7(1) and 2A.7.7(2). Such facilities and areas shall be designed and constructed in accordance with Section 2B.15.9.
- 2A.7.8 Multiple hazards.** Buildings and structures containing a material or materials representing hazards that are classified in one or more of Groups H-1, H-2, H-3 and H-4 shall conform to the code requirements for each of the occupancies so classified.
- 2A.7.9 Exceptions:** The following shall not be classified in Group H, but shall be classified in the occupancy which they most nearly resemble. Hazardous materials in any quantity shall conform to the requirements of SBC 201, including Section 2B.14, and these code requirements:
1. Buildings and structures that contain not more than the maximum allowable quantities per control area of hazardous materials as shown in Tables 2A.7.7(1) and 2A.7.7(2) provided that such buildings are maintained in accordance with these code requirements.

2. Buildings utilizing control areas in accordance with Section 2B.14.2 that contain not more than the maximum allowable quantities per control area of hazardous materials as shown in Tables 2A.7.7(1) and 2A.7.7(2).
3. Buildings and structures occupied for the application of flammable finishes, provided that such buildings or areas conform to the requirements of Section 2B16 and these code requirements.
4. Wholesale and retail sales and storage of flammable and combustible liquids in mercantile occupancies conforming to these code requirements.
5. Closed systems housing flammable or combustible liquids or gases utilized for the operation of machinery or equipment.

TABLE 2A.7.7(1)

**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD<sup>a, j, m</sup>**

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE <sup>b</sup>			USE-CLOSED SYSTEMS <sup>b</sup>					USE-OPEN SYSTEMS <sup>b</sup>		
			Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	Liquid liters (kgs)
Combustible liquid <sup>c, i</sup>	II	H-2 or H-3	Not Applicable	454 <sup>d, e</sup>	Not Applicable	Not Applicable	454 <sup>d</sup>	Not Applicable	454 <sup>d</sup>	Not Applicable	Not Applicable	114 <sup>d</sup>	114 <sup>d</sup>
	IIIA	H-2 or H-3	Not Applicable	1,249 <sup>d, e</sup>	Not Applicable	Not Applicable	1,249 <sup>d</sup>	Not Applicable	1,249 <sup>d</sup>	Not Applicable	Not Applicable	303 <sup>d</sup>	303 <sup>d</sup>
Combustible fiber	IIIB	Not Applicable	Not Applicable	49,962 <sup>e, f</sup>	Not Applicable	Not Applicable	49,962 <sup>e, f</sup>	Not Applicable	49,962 <sup>e, f</sup>	Not Applicable	Not Applicable	12,491 <sup>f</sup>	12,491 <sup>f</sup>
	Loose	H-3	(2.8)	Not Applicable	Not Applicable	(2.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	(0.57)	Not Applicable	Not Applicable
Cryogenic Flammable	Baled	H-3	(28)	Not Applicable	Not Applicable	(28)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	(5.7)	Not Applicable	Not Applicable
	Not	H-2	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	170 <sup>d</sup>	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	38 <sup>d</sup>	38 <sup>d</sup>
Consumer fireworks (Class C Common)	Applicable	H-2	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	1.4G	H-3	56.8 <sup>d, e, 1</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Cryogenic Oxidizing	Not	H-3	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	170 <sup>d</sup>	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	38 <sup>d</sup>	38 <sup>d</sup>
	Applicable	H-3	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Explosives	Division 1.1	H-1	0.45 <sup>c, g</sup>	(0.45) <sup>c, g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	(0.114) <sup>g</sup>
	Division 1.2	H-1	0.45 <sup>c, g</sup>	(0.45) <sup>c, g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	(0.114) <sup>g</sup>
	Division 1.3	H-1 or H-2	2.3 <sup>e, g</sup>	(2.3) <sup>e, g</sup>	Not Applicable	0.45 <sup>g</sup>	(0.45) <sup>g</sup>	Not Applicable	(0.45) <sup>g</sup>	Not Applicable	0.45 <sup>g</sup>	(0.45) <sup>g</sup>	(0.45) <sup>g</sup>
	Division 1.4	H-3	22.7 <sup>e, g</sup>	(22.7) <sup>e, g</sup>	Not Applicable	22.7 <sup>g</sup>	(22.7) <sup>g</sup>	Not Applicable	(22.7) <sup>g</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Division 1.4G	H-3	56.8 <sup>d, e, 1</sup>	(56.8) <sup>d, e, 1</sup>	Not Applicable	Not Applicable	(56.8) <sup>d, e, 1</sup>	Not Applicable	(56.8) <sup>d, e, 1</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Division 1.5	H-1	0.45 <sup>c, g</sup>	(0.45) <sup>c, g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	(0.114) <sup>g</sup>
Flammable gas	Division 1.6	H-1	0.45 <sup>d, e, g</sup>	(0.45) <sup>d, e, g</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Gaseous	H-2	Not Applicable	Not Applicable	28 <sup>d, e</sup>	Not Applicable	Not Applicable	28 <sup>d, e</sup>	Not Applicable	28 <sup>d, e</sup>	Not Applicable	Not Applicable	Not Applicable
Flammable liquids <sup>c</sup>	Liquefied	H-2	Not Applicable	114 <sup>d, e</sup>	Not Applicable	Not Applicable	114 <sup>d, e</sup>	Not Applicable	114 <sup>d, e</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	IA	H-2 or H-3	Not Applicable	114 <sup>d, e</sup>	Not Applicable	Not Applicable	114 <sup>d, e</sup>	Not Applicable	114 <sup>d, e</sup>	Not Applicable	Not Applicable	38 <sup>d</sup>	38 <sup>d</sup>
Combination Flammable liquid (IA, IB, IC)	IB and IC	H-2 or H-3	Not Applicable	454 <sup>d, e</sup>	Not Applicable	Not Applicable	454 <sup>d, e</sup>	Not Applicable	454 <sup>d, e</sup>	Not Applicable	Not Applicable	114 <sup>d</sup>	114 <sup>d</sup>
	Not	H2 or H-3	Not Applicable	454 <sup>d, e, h</sup>	Not Applicable	Not Applicable	454 <sup>d, e, h</sup>	Not Applicable	454 <sup>d, e, h</sup>	Not Applicable	Not Applicable	114 <sup>d, h</sup>	114 <sup>d, h</sup>
Flammable solid	Applicable	H-3	54.5 <sup>d, e</sup>	Not Applicable	Not Applicable	56.8 <sup>d</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable	11.4 <sup>d</sup>	Not Applicable	Not Applicable
	UD	H-1	0.45 <sup>c, f</sup>	(0.45) <sup>c, f</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	(0.114) <sup>g</sup>
Organic peroxide	I	H-2	2.3 <sup>d, e</sup>	(2.3) <sup>d, e</sup>	Not Applicable	0.45 <sup>d</sup>	(0.45) <sup>d</sup>	Not Applicable	(0.45) <sup>d</sup>	Not Applicable	0.45 <sup>d</sup>	(0.45) <sup>d</sup>	(0.45) <sup>d</sup>
	II	H-3	22.7 <sup>d, e</sup>	(22.7) <sup>d, e</sup>	Not Applicable	22.7 <sup>d</sup>	(22.7) <sup>d</sup>	Not Applicable	(22.7) <sup>d</sup>	Not Applicable	22.7 <sup>d</sup>	(22.7) <sup>d</sup>	(22.7) <sup>d</sup>
	III	H-3	56.8 <sup>d, e</sup>	(56.8) <sup>d, e</sup>	Not Applicable	56.8 <sup>d</sup>	(56.8) <sup>d</sup>	Not Applicable	(56.8) <sup>d</sup>	Not Applicable	56.8 <sup>d</sup>	(56.8) <sup>d</sup>	(56.8) <sup>d</sup>
	IV	Not Applicable	Not limited	Not limited	Not Applicable	Not limited	Not limited	Not Applicable	Not limited	Not Applicable	Not limited	Not limited	Not limited
Organic peroxide	V	Not Applicable	Not limited	Not limited	Not Applicable	Not limited	Not limited	Not Applicable	Not limited	Not Applicable	Not limited	Not limited	Not limited
	V	Not Applicable	Not limited	Not limited	Not Applicable	Not limited	Not limited	Not Applicable	Not limited	Not Applicable	Not limited	Not limited	Not limited

(continued)

**TABLE 2A.7.7(1)—(continued)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD<sup>a, j, m</sup>**

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE <sup>b</sup>			USE-CLOSED SYSTEMS <sup>b</sup>				USE-OPEN SYSTEMS <sup>b</sup>	
			Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	Liquid liters (kgs)
Oxidizer	4	H-1	0.45 <sup>c, g</sup>	(0.45) <sup>c, g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	(0.114) <sup>g</sup>
	3 <sup>k</sup>	H-2	4.5 <sup>d, e</sup>	(4.5) <sup>d, e</sup>		0.9 <sup>d</sup>	(0.9) <sup>d</sup>		0.9 <sup>d</sup>	(0.9) <sup>d</sup>	(0.9) <sup>d</sup>
	2	H-3	113.5 <sup>d, e</sup>	(113.5) <sup>d, e</sup>		113.5 <sup>d</sup>	(113.5) <sup>d</sup>		22.7 <sup>d</sup>	(22.7) <sup>d</sup>	(22.7) <sup>d</sup>
	1	H-3	1,816 <sup>e, f</sup>	(1,816) <sup>e, f</sup>		1,816 <sup>f</sup>	(1,816) <sup>f</sup>		454 <sup>f</sup>	(454) <sup>f</sup>	(454) <sup>f</sup>
Oxidizing gas	Gaseous Liquefied	H-3	Not Applicable	Not Applicable	42.5 <sup>d, e</sup>	Not Applicable	Not Applicable	42.5 <sup>d, e</sup>	Not Applicable	Not Applicable	Not Applicable
Pyrophoric material	Not Applicable	H-2	1.8 <sup>c, g</sup>	(1.8) <sup>c, g</sup>	1.42 <sup>c, g</sup>	0.45 <sup>g</sup>	(0.45) <sup>g</sup>	0.28 <sup>c, g</sup>	0	0	0
Unstable (reactive)	4	H-1	0.45 <sup>c, g</sup>	(0.45) <sup>c, g</sup>	0.28 <sup>c, g</sup>	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	0.057 <sup>c, g</sup>	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	(0.114) <sup>g</sup>
	3	H-1 or H-2	2.3 <sup>d, e</sup>	(2.3) <sup>d, e</sup>	1.42 <sup>d, e</sup>	0.45 <sup>d, e</sup>	(0.45) <sup>d, e</sup>	0.28 <sup>d, e</sup>	0.45 <sup>d</sup>	(0.45) <sup>d</sup>	(0.45) <sup>d</sup>
	2	H-3	22.7 <sup>d, e</sup>	(22.7) <sup>d, e</sup>	7.1 <sup>d, e</sup>	22.7 <sup>d</sup>	(22.7) <sup>d</sup>	7.1 <sup>d, e</sup>	4.5 <sup>d</sup>	(4.5) <sup>d</sup>	(4.5) <sup>d</sup>
Water reactive	1	Not Applicable	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited
	3	H-2	2.3 <sup>d, e</sup>	(2.3) <sup>d, e</sup>	Not	2.3 <sup>d</sup>	(2.3) <sup>d</sup>	Not	0.45 <sup>d</sup>	(0.45) <sup>d</sup>	(0.45) <sup>d</sup>
	2	H-3	22.7 <sup>d, e</sup>	(22.7) <sup>d, e</sup>	Applicable	22.7 <sup>d</sup>	(22.7) <sup>d</sup>	Applicable	4.5 <sup>d</sup>	(4.5) <sup>d</sup>	(4.5) <sup>d</sup>
	1	Not Applicable	Not Limited	Not Limited		Not Limited	Not Limited		Not Limited	Not Limited	Not Limited

NL = Not Limited; N/A = Not Applicable; UD = Unclassified Detonable

a. For use of control areas, see Section 2B.14.2.

b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

c. The quantities of alcoholic beverages in retail and wholesale sales occupancies shall not be limited providing the liquids are packaged in individual containers not exceeding 5 liters. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs, consumer or industrial products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 5 liters.

d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

e. Quantities shall be increased 100 percent when stored in approved cabinets, gas cabinets, exhausted enclosures or safety cans as specified in these code *requirements*. Where Note d also applies, the increase for both notes shall be applied accumulatively.

f. The permitted quantities shall not be limited in a building equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

g. Permitted only in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

h. Containing not more than the maximum allowable quantity per control area of Class IA, IB or IC flammable liquids.

i. Inside a building, the maximum capacity of a combustible liquid storage system that is connected to a fuel-oil piping system shall be 2,498 liters provided such system conforms to *these code requirements*.

j. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.

k. A maximum quantity of 91 kilograms of solid or 76 liters of liquid Class 3 oxidizers is allowed when such materials are necessary for maintenance purposes, operation or sanitation of equipment. Storage containers and the manner of storage shall be approved.

l. Net weight of the pyrotechnic composition of the fireworks. Where the net weight of the pyrotechnic composition of the fireworks is not known, 25 percent of the gross weight of the fireworks, including packaging, shall be used.

m. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 2B.14.2.4, see Table 2B.14.2.4.



TABLE 2A.7.7(2)  
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD<sup>a,b,c</sup>

MATERIAL	STORAGE <sup>d</sup>		USE-CLOSED SYSTEMS <sup>b</sup>		USE-OPEN SYSTEMS <sup>b</sup>	
	Solid kgs <sup>e,f</sup>	Liquid liters (kgs) <sup>e,f</sup>	Gas cubic meters <sup>e</sup>	Solid kgs <sup>e</sup>	Gas cubic meters <sup>e</sup>	Liquid liters (kgs) <sup>e</sup>
Corrosive	2,270	1,893	23 <sup>f,g</sup>	2,270	23 <sup>f,g</sup>	379
Highly toxic	4.5	(4.5) <sup>i</sup>	0.57 <sup>h</sup>	4.5	0.57 <sup>h</sup>	(1.4) <sup>i</sup>
Toxic	227	(227) <sup>i</sup>	23 <sup>f</sup>	227	23 <sup>f</sup>	(56.8) <sup>i</sup>

- a. For use of control areas, see Section 2B.14.2.
- b. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs consumer or industrial products, and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 5 liters.
- c. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 2B.14.2.4, see Table 2B.14.2.4.
- d. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
- e. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. Where Note f also applies, the increase for both notes shall be applied accumulatively.
- f. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets, or exhausted enclosures. Where Note e also applies, the increase for both notes shall be applied accumulatively.
- g. A single cylinder containing 68 kilograms or less of anhydrous ammonia in a single control area in a nonsprinklered building shall be considered a maximum allowable quantity. Two cylinders, each containing 68 kilograms or less in a single control area shall be considered a maximum allowable quantity provided the building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
- h. Allowed only when stored in approved exhausted gas cabinets or exhausted enclosures.
- i. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.

6. Cleaning establishments that utilize combustible liquid solvents having a flash point of 60°C or higher in closed systems employing equipment listed by an approved testing agency, provided that this occupancy is separated from all other areas of the building by 1 hour fire-resistance-rated fire barrier walls or horizontal assemblies or both.
7. Cleaning establishments which utilize a liquid solvent having a flash point at or above 93°C.
8. Refrigeration systems.
9. The storage or utilization of materials for agricultural purposes on the premises.
10. Stationary batteries utilized for facility emergency power, uninterrupted power supply or telecommunication facilities provided that the batteries are provided with safety venting caps and ventilation is provided in accordance with the SBC 501.
11. Corrosives shall not include personal or household products in their original packaging used in retail display or commonly used building materials.
12. Buildings and structures occupied for aerosol storage shall be classified as Group S-1, provided that such buildings conform to the requirements of these code requirements.
13. Display and storage of nonflammable solid and nonflammable or noncombustible liquid hazardous materials in quantities not exceeding the maximum allowable quantity per control area in Group M or S occupancies complying with Section 2B14.2.4 (Hazardous Materials).
14. The storage of black powder, smokeless propellant and small arms primers in Groups M and R-3 and special industrial explosive devices in Groups B, F, M and S, provided such storage conforms to the quantity limits and requirements prescribed in these code requirements.

## SECTION 2A.8 INSTITUTIONAL GROUP I

**2A.8.1 Institutional Group I.** Institutional Group I occupancy includes, among others, the use of a building or structure, or a portion thereof, in which people are cared for or live in a supervised environment, having physical limitations because of health or age are harbored for medical treatment or other care or treatment, or in which people are detained for penal or correctional purposes or in which the liberty of the occupants is restricted. Institutional occupancies shall be classified as Group I-1, I-2, I-3 or I-4.

**2A.8.2 Group I-1.** This occupancy shall include buildings, structures or parts thereof housing more than 16 persons, on a 24-hour basis, who because of age, mental disability or other reasons, live in a supervised residential environment that provides personal care services. The occupants are capable of responding to an emergency situation without physical assistance from staff. This group shall include, but not be limited to, the following:

Residential board and care facilities  
 Assisted living facilities  
 Halfway houses  
 Group homes  
 Congregate care facilities  
 Social rehabilitation facilities  
 Alcohol and drug treatment centers

## Convalescent facilities

A facility such as the above with five or fewer persons shall be classified as a Group R-3 or shall comply with SBC 100. A facility such as above, housing at least six and not more than 16 persons, shall be classified as Group R-4.

- 2A.8.3 Group I-2.** This occupancy shall include buildings and structures used for medical, surgical, psychiatric, nursing or custodial care on a 24-hour basis of more than five persons who are not capable of self-preservation. This group shall include, but not be limited to, the following:  
Hospitals  
Nursing homes (both intermediate-care facilities and skilled nursing facilities)  
Mental hospitals  
Detoxification facilities  
A facility such as the above with five or fewer persons shall be classified as Group R-3 or shall comply with SBC 100
- 2A.8.3.1 Child care facility.** A child care facility that provides care on a 24-hour basis to more than five children 2<sup>1</sup>/<sub>2</sub> years of age or less shall be classified as Group I-2.
- 2A.8.4 Group I-3.** This occupancy shall include buildings and structures that are inhabited by more than five persons who are under restraint or security. An I-3 facility is occupied by persons who are generally incapable of self-preservation due to security measures not under the occupants' control. This group shall include, but not be limited to, the following:  
Prisons  
Jails  
Reformatories  
Detention centers  
Correctional centers  
Prerelease centers  
Buildings of Group I-3 shall be classified as one of the occupancy conditions indicated in Sections 2A.8.4.1 through 2A.8.4.5 (see Section 2B.8.1).
- 2A.8.4.1 Condition 1.** This occupancy condition shall include buildings in which free movement is allowed from sleeping areas, and other spaces where access or occupancy is permitted, to the exterior via means of egress without restraint. A Condition 1 facility is permitted to be constructed as Group R.
- 2A.8.4.2 Condition 2.** This occupancy condition shall include buildings in which free movement is allowed from sleeping areas and any other occupied smoke compartment to one or more other smoke compartments. Egress to the exterior is impeded by locked exits.
- 2A.8.4.3 Condition 3.** This occupancy condition shall include buildings in which free movement is allowed within individual smoke compartments, such as within a residential unit comprised of individual sleeping units and group activity spaces, where egress is impeded by remote-controlled release of means of egress from such a smoke compartment to another smoke compartment.
- 2A.8.4.4 Condition 4.** This occupancy condition shall include buildings in which free movement is restricted from an occupied space. Remote-controlled release is provided to permit movement from sleeping units, activity spaces and other occupied areas within the smoke compartment to other smoke compartments.
- 2A.8.4.5 Condition 5.** This occupancy condition shall include buildings in which free movement is restricted from an occupied space. Staff-controlled manual release is provided to permit movement from sleeping units, activity spaces and other occupied areas within the smoke compartment to other smoke compartments.

- 2A.8.5 Group I-4, day care facilities.** This group shall include buildings and structures occupied by persons of any age who receive custodial care for less than 24 hours by individuals other than parents or guardians, relatives by blood, marriage or orphanage, and in a place other than the home of the person cared for. A facility such as the above with five or fewer persons shall be classified as a Group R-3 or shall comply with SBC 100. Places of worship during religious functions are not included.
- 2A.8.5.1 Adult care facility.** A facility that provides accommodations for less than 24 hours for more than five unrelated adults and provides supervision and personal care services shall be classified as Group I-4.  
**Exception:** A facility where occupants are capable of responding to an emergency situation without physical assistance from the staff shall be classified as Group A-3.
- 2A.8.5.2 Child care facility.** A facility that provides supervision and personal care on less than a 24-hour basis for more than five children 2<sup>1</sup>/<sub>2</sub> years of age or less shall be classified as Group I-4.  
**Exception:** A child day care facility that provides care for more than five but no more than 100 children 2<sup>1</sup>/<sub>2</sub> years or less of age, when the rooms where such children are cared for are located on the level of exit discharge and each of these child care rooms has an exit door directly to the exterior, shall be classified as Group E.

## SECTION 2A.9 MERCANTILE GROUP M

- 2A.9.1 Mercantile Group M.** Mercantile Group M occupancy includes, among others, buildings and structures or a portion thereof, for the display and sale of merchandise, and involves stocks of goods, wares or merchandise incidental to such purposes and accessible to the public. Mercantile occupancies shall include, but not be limited to, the following:  
 Department stores  
 Drug stores  
 Markets  
 Motor fuel-dispensing facilities  
 Retail or wholesale stores  
 Sales rooms
- 2A.9.2 Quantity of hazardous materials.** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored or displayed in a single control area of a Group M occupancy shall not exceed the quantities in Table 2B.14.2.4.

## SECTION 2A.10 RESIDENTIAL GROUP R

- 2A.10.1 Residential Group R.** Residential Group R includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classified as an Institutional Group I. Residential occupancies shall include the following:  
**R-1** Residential occupancies where the occupants are primarily transient in nature, including:  
 Boarding houses (transient)

Hotels (transient)

Motels (transient)

**R-2** Residential occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature, including:

Apartment houses

Boarding houses (not transient)

Dormitories

Fraternities and sororities

Vacation timeshare properties

Hotels (non-transient)

Motels (non-transient)

**R-3** Residential occupancies where the occupants are primarily permanent in nature and not classified as R-1, R-2, R-4 or I and where buildings do not contain more than two dwelling units as applicable in SBC 100, or adult and child care facilities that provide accommodations for five or fewer persons of any age for less than 24 hours. Adult and child care facilities that are within a single-family home are permitted to comply with SBC 100.

**R-4** Residential occupancies shall include buildings arranged for occupancy as residential care/assisted living facilities including more than five but not more than 16 occupants, excluding staff.

Group R-4 occupancies shall meet the requirements for construction as defined for Group R-3 except as otherwise provided for in SBC 201 or in accordance with SBC 100.

**2A.10.2 Definitions.** The following words and terms shall, for the purposes of this section and as used elsewhere in these code requirements, have the meanings shown herein.

**BOARDING HOUSE.** A building arranged or used for lodging for compensation, with or without meals, and not occupied as a single-family unit.

**DORMITORY.** A space in a building where group sleeping accommodations are provided in one room, or in a series of closely associated rooms, for persons not members of the same family group, under joint occupancy and single management, as in college dormitories or fraternity houses.

**DWELLING UNIT.** A single unit providing complete, independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

**PERSONAL CARE SERVICE.** The care of residents who do not require chronic or convalescent medical or nursing care. Personal care involves responsibility for the safety of the resident while inside the building.

**RESIDENTIAL CARE/ASSISTED LIVING FACILITIES.** A building or part thereof housing persons, on a 24-hour basis, who because of age, mental disability or other reasons, live in a supervised residential environment which provides personal care services. The occupants are capable of responding to an emergency situation without physical assistance from staff. This classification shall include, but not be limited to, the following: residential board and care facilities, assisted living facilities, halfway houses, group homes, congregate care facilities, social rehabilitation facilities, alcohol and drug abuse treatment centers and convalescent facilities.

## SECTION 2A.11

### STORAGE GROUP S

- 2A.11.1 Storage Group S.** Storage Group S occupancy includes, among others, the use of a building or structure, or a portion thereof, for storage that is not classified as a hazardous occupancy.
- 2A.11.2 Moderate-hazard storage, Group S-1.** Buildings occupied for storage uses which are not classified as Group S-2 including, but not limited to, storage of the following:
- Aerosols, Levels 2 and 3
  - Aircraft repair hangar
  - Bags; cloth, burlap and paper
  - Bamboos and rattan
  - Baskets
  - Belting; canvas and leather
  - Books and paper in rolls or packs
  - Boots and shoes
  - Buttons, including cloth covered, pearl or bone
  - Cardboard and cardboard boxes
  - Clothing, woolen wearing apparel cordage
  - Furniture
  - Furs
  - Glues, mucilage, pastes and size
  - Grains
  - Horns and combs, other than celluloid
  - Leather
  - Linoleum
  - Lumber
  - Motor vehicle repair garages complying with the maximum allowable quantities of hazardous materials listed in Table 2A.7.7(1) (see Section 2B.6.6)
  - Photo engravings resilient flooring silks
  - Soaps
  - Sugar
  - Tires, bulk storage of
  - Tobacco, cigars, and cigarettes
  - Upholstery and mattresses
  - Wax candles
- 2A.11.3 Low-hazard storage, Group S-2.** Includes, among others, buildings used for the storage of noncombustible materials such as products on wood pallets or in paper cartons with or without single thickness divisions; or in paper wrappings. Such products are permitted to have a negligible amount of plastic trim, such as knobs, handles or film wrapping. Storage uses shall include, but not be limited to, storage of the following:
- Aircraft hangar
  - Asbestos
  - Medical products up to and including 12-percent alcohol in metal, glass or ceramic containers
  - Cement in bags
  - Chalk and crayons
  - Dairy products in non-waxed coated paper containers

Dry cell batteries  
 Electrical coils electrical motors  
 Empty cans  
 Food products  
 Foods in noncombustible containers  
 Fresh fruits and vegetables in non-plastic trays or containers  
 Frozen foods  
 Glass  
 Glass bottles, empty or filled with noncombustible liquids  
 Gypsum board  
 Inert pigments  
 Ivory  
 Meats  
 Metal cabinets  
 Metal desks with plastic tops and trim  
 Metal parts  
 Metals  
 Mirrors  
 Oil-filled and other types of distribution transformers  
 Parking garages, open or enclosed  
 Porcelain and pottery  
 Stoves  
 Talc and soap stones  
 Washers and dryers

## SECTION 2A.12

### UTILITY AND MISCELLANEOUS GROUP U

**2A.12.1 General.** Buildings and structures of an accessory character and miscellaneous structures not classified in any specific occupancy shall be constructed, equipped and maintained to conform to the requirements of the *Saudi Building Code* commensurate with the fire and life hazard incidental to their occupancy. Group U shall include, but not be limited to, the following:

Agricultural buildings  
 Aircraft hangars, accessory to a one- or two-family residence (see Section 2B.12.3)  
 Barns  
 Carports  
 Fences more than 1.8 m high  
 Grain silos, accessory to a residential occupancy  
 Greenhouses  
 Livestock shelters  
 Private garages  
 Retaining walls  
 Sheds  
 Stables  
 Tanks  
 Towers



**SECTION 2B**  
**SPECIAL DETAILED REQUIREMENTS BASED ON**  
**USE AND OCCUPANCY**

**SECTION 2B.1**  
**SCOPE**

- 2B.1.1 Detailed use and occupancy requirements.** In addition to the occupancy and construction requirements in these code requirements, the provisions of this chapter apply to the special uses and occupancies described herein.

**SECTION 2B.2**  
**COVERED MALL BUILDINGS**

- 2B.2.1 Scope.** The provisions of this section shall apply to buildings or structures defined herein as covered mall buildings not exceeding three floor levels at any point nor more than three stories above grade. Except as specifically required by this section, covered mall buildings shall meet applicable provisions of these code requirements.

**Exceptions:**

1. Foyers and lobbies of Groups B, R-1 and R-2 are not required to comply with this section.
2. Buildings need not comply with the provisions of this section where they totally comply with other applicable provisions of these code requirements.

- 2B.2.2 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**ANCHOR BUILDING.** An exterior perimeter building of a group other than H having direct access to a covered mall building but having required means of egress independent of the mall.

**COVERED MALL BUILDING.** A single building enclosing a number of tenants and occupants such as retail stores, drinking and dining establishments, entertainment and amusement facilities, passenger transportation terminals, offices, and other similar uses wherein two or more tenants have a main entrance into one or more malls. For the purpose of this chapter, anchor buildings shall not be considered as a part of the covered mall building.

**FOOD COURT.** A public separate seating area for male/families located in the mall that serves adjacent food preparation tenant spaces.

**GROSS LEASABLE AREA.** The total floor area designed for tenant occupancy and exclusive use. The area of tenant occupancy is measured from the centerlines of joint partitions to the outside of the tenant walls. All tenant areas, including areas used for storage, shall be included in calculating gross leasable area.

**MALL.** A roofed or covered common pedestrian area within a covered mall building that serves as access for two or more tenants and not to exceed three levels that are open to each other.



**2B.2.3 Lease plan.** Each covered mall building owner shall provide both the building authority and fire civil defense – with a lease plan showing the location of each occupancy and its exits after the certificate of occupancy has been issued. No modifications or changes in occupancy or use shall be made from that shown on the lease plan without prior approval of the building official.

**2B.2.4 Means of egress.** Each tenant space and the covered mall building shall be provided with means of egress as required by this section and these code requirements. Where there is a conflict between the requirements of these code requirements and the requirements of this section, the requirements of this section shall apply.

**2B.2.4.1 Determination of occupant load.** The occupant load permitted in any individual tenant space in a covered mall building shall be determined as required by these code requirements. Means of egress requirements for individual tenant spaces shall be based on the occupant load thus determined.

**2B.2.4.1.1 Occupant formula.** In determining required means of egress of the mall, the number of occupants for whom means of egress are to be provided shall be based on gross leasable area of the covered mall building (excluding anchor buildings) and the occupant load factor as determined by the following equation.

$$OLF = ((0.00007) (GLA) + 25) \times 0.0929 \quad \text{(Equation 4-1)}$$

Where:

*OLF* = The occupant load factor (square meters per person).

*GLA* = The gross leasable area (square meters).

**2B.2.4.1.2 OLF range.** The occupant load factor (*OLF*) is not required to be less than 2.8 and shall not exceed 4.6.

**2B.2.4.1.3 Anchor buildings.** The occupant load of anchor buildings opening into the mall shall not be included in computing the total number of occupants for the mall.

**2B.2.4.1.4 Food courts.** The occupant load of a food court shall be determined in accordance with Section 8.3. For the purposes of determining the means of egress requirements for the mall, the food court occupant load shall be added to the occupant load of the covered mall building as calculated above.

**2B.2.4.2 Number of means of egress.** Wherever the distance of travel to the mall from any location within a tenant space used by persons other than employees exceeds 23 m or the tenant space exceeds an occupant load of 50, not less than two means of egress shall be provided.

**2B.2.4.3 Arrangements of means of egress.** Assembly occupancies with an occupant load of 500 or more shall be so located in the covered mall building that their entrance will be immediately adjacent to a principal entrance to the mall and shall have not less than one-half of their required means of egress opening directly to the exterior of the covered mall building.

**2B.2.4.3.1 Anchor building means of egress.** Required means of egress for anchor buildings shall be provided independently from the mall means of egress system. The occupant load of anchor buildings opening into the mall shall not be included in determining means of egress requirements for the mall. The path of egress travel of malls shall not exit through anchor buildings. Malls terminating at an anchor building where no other means of egress has been provided shall be considered as a dead-end mall.

**2B.2.4.4 Distance to exits.** Within each individual tenant space in a covered mall building, the maximum distance of travel from any point to an exit or entrance to the mall

shall not exceed 61 m.

The maximum distance of travel from any point within a mall to an exit shall not exceed 61 m.

- 2B.2.4.5 Access to exits.** Where more than one exit is required, they shall be so arranged that it is possible to travel in either direction from any point in a mall to separate exits. The minimum width of an exit passageway or corridor from a mall shall be 1.7 m.

**Exception:** Dead ends not exceeding a length equal to twice the width of the mall measured at the narrowest location within the dead-end portion of the mall.

- 2B.2.4.5.1 Exit passageway enclosures.** Where exit passageway enclosures provide a secondary means of egress from a tenant space, doors to the exit passageway enclosures shall be 1 hour fire doors. Such doors shall be self-closing and be so maintained or shall be automatic-closing by smoke detection.

- 2B.2.4.6 Service areas fronting on exit passageways.** Mechanical rooms, electrical rooms, building service areas and service elevators are permitted to open directly into exit passageways provided that the exit passageway is separated from such rooms with 1 hour fire-resistance-rated walls and 1 hour opening protectives.

- 2B.2.5 Mall width.** For the purpose of providing required egress, malls are permitted to be considered as corridors but need not comply with the requirements of Section 8.5.1 of these code requirements where the width of the mall is as specified in this section.

- 2B.2.5.1 Minimum width.** The minimum width of the mall shall be 6.1 m. The mall width shall be sufficient to accommodate the occupant load served. There shall be a minimum of 3.1 m clear exit width to a height of 2.4 m between any projection of a tenant space bordering the mall and the nearest kiosk, vending machine, bench, display opening, food court or other obstruction to means of egress travel.

- 2B.2.6 Types of construction.** The area of any covered mall building, including anchor buildings, of Type I, II, III and IV construction, shall not be limited provided the covered mall building and attached anchor buildings and parking garages are surrounded on all sides by a permanent open space of not less than 18.3 m and the anchor buildings do not exceed three stories in height. The allowable height and area of anchor buildings greater than three stores in height shall comply with Section 3.3, as modified by Sections 3.4 and 3.6. The construction type of open parking garages and enclosed parking garages shall comply with Sections 2B.6.3 and 2B.6.4 respectively.

- 2B.2.7 Fire-resistance-rated separation.** Fire-resistance-rated separation is not required between tenant spaces and the mall. Fire-resistance-rated separation is not required between a food court and adjacent tenant spaces or the mall.

- 2B.2.7.1 Attached garage.** An attached garage for the storage of passenger vehicles having a capacity of not more than nine persons and open parking garages shall be considered as a separate building where it is separated from the covered mall building by a fire barrier having a fire-resistance rating of at least 2 hours.

**Exception:** Where an open parking garage or enclosed parking garage is separated from the covered mall building or anchor building a distance greater than 3.1 m, the provisions of Table 4A.2 shall apply. Pedestrian walkways and tunnels which attach the open parking garage or enclosed parking garage to the covered mall building or anchor building shall be constructed in accordance with Section 4.4 of SBC 201.

- 2B.2.7.2 Tenant separations.** Each tenant space shall be separated from other tenant spaces

by a fire partition complying with Section 4B.8. A tenant separation wall is not required between any tenant space and the mall.

**2B.2.7.3 Anchor building separation.** An anchor building shall be separated from the covered mall building by fire walls complying with Section 4B.6.

**Exception:** Anchor buildings of not more than three stories above grade which have an occupancy classification of the same uses permitted as tenants of the covered mall building shall be separated by 2 hours fire resistive fire-barriers complying with Section 4B.6.

**2B.2.7.3.1 Openings between anchor building and mall.** Except for the separation between Group R-1 sleeping units and the mall, openings between anchor buildings of Type IA, IB, IIA and IIB construction and the mall need not be protected.

**2B.2.8 Automatic sprinkler system.** The covered mall building and buildings connected shall be provided throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, which shall comply with the following:

1. The automatic sprinkler system shall be complete and operative throughout occupied space in the covered mall building prior to occupancy of any of the tenant spaces. Unoccupied tenant spaces shall be similarly protected unless provided with approved alternate protection.
2. Sprinkler protection for the mall shall be independent from that provided for tenant spaces or anchors. Where tenant spaces are supplied by the same system, they shall be independently controlled.

**Exception:** An automatic sprinkler system shall not be required in spaces or areas of open parking garages constructed in accordance with Section 2B.6.2.

**2B.2.8.1 Standpipe system.** The covered mall building shall be equipped throughout with a standpipe system as required by Section 7.5.3.3.

**2B.2.9 Smoke control.** A smoke control system shall be provided where required for atriums in Section 2B.4.

**2B.2.10 Kiosks.** Kiosks and similar structures (temporary or permanent) shall meet the following requirements:

1. Combustible kiosks or other structures shall not be located within the mall unless constructed of any of the following materials:
  - 1.1 Fire-retardant-treated wood complying with Section 11.14 of SBC 201.
  - 1.2 Foam plastics having a maximum heat release rate not greater than 105 Btu/h when tested in accordance with the exhibit booth protocol in UL 1975.
  - 1.3 Aluminum composite material (ACM) having a flame spread index of not more than 25 and a smoke-developed index of not more than 450 when tested as an assembly in the maximum thickness intended for use in accordance with ASTM E 84.
2. Kiosks or similar structures located within the mall shall be provided with approved fire suppression and detection devices.
3. The minimum horizontal separation between kiosks or groupings thereof and other structures within the mall shall be 6.1 m.
4. Each kiosk or similar structure or groupings thereof shall have a maximum area of 28 m<sup>2</sup>.

**2B.2.11 Security grilles and doors.** Horizontal sliding or vertical security grilles or doors that are a part of a required means of egress shall conform to the following:

1. They shall remain in the full open position during the period of occupancy by

the general public.

2. Doors or grilles shall not be brought to the closed position when there are more than 10 persons occupying spaces served by a single exit or 50 persons occupying spaces served by more than one exit.
3. The doors or grilles shall be openable from within without the use of any special knowledge or effort where the space is occupied.
4. Where two or more exits are required, not more than one-half of the exits shall be permitted to include either a horizontal sliding or vertical rolling grille or doors.

**2B.2.12 Standby power.** Covered mall buildings exceeding 4,645 m<sup>2</sup> shall be provided with standby power systems that are capable of operating the emergency voice/alarm communication system.

**2B.2.13 Emergency voice/alarm communication system.** Covered mall buildings exceeding 4,645 m<sup>2</sup> in total floor area shall be provided with an emergency voice/alarm communication system. Emergency voice/alarm communication systems serving a mall required or otherwise, shall be accessible to the fire - civil defense. The system shall be provided in accordance with Section 7.7.2.12.2.

**2B.2.14 Plastic signs.** Within every store or level and from sidewall to sidewall of each tenant space facing the mall, plastic signs shall be limited as specified in Sections 2B.2.14.1 through 2B.2.14.5.

**2B.2.14.1 Area.** Plastic signs shall not exceed 20 percent of the wall area facing the mall.

**2B.2.14.2 Height and width.** Plastic signs shall not exceed a height of 914 mm, except if the sign is vertical, the height shall not exceed 2438 mm and the width shall not exceed 914 mm.

**2B.2.14.3 Location.** Plastic signs shall be located a minimum distance of 457 mm from adjacent tenants.

**2B.2.14.4 Plastics other than foam plastics.** Plastics other than foam plastics used in signs shall be light-transmitting plastics complying with Section 11.6.4 of SBC 201 or shall have a self-ignition temperature of 343°C or greater when tested in accordance with ASTM D 1929, and a flame spread index not greater than 75 and smoke-developed index not greater than 450 when tested in the manner intended for use in accordance with ASTM E 84 or meet the acceptance criteria of Section 6.3.2.1 when tested in accordance with NFPA 286.

**2B.2.14.4.1 Encasement.** Edges and backs of plastic signs in the mall shall be fully encased in metal.

**2B.2.14.5 Foam plastics.** Foam plastics used in signs shall have flame-retardant characteristics such that the sign has a maximum heat-release rate of 150 kilowatts when tested in accordance with UL 1975 and the foam plastics shall have the physical characteristics specified in this section. Foam plastics used in signs installed in accordance with Section 2B.2.14 shall not be required to comply with the flame spread and smoke-developed indexes specified in Section 11.3.3 of SBC 201.

**2B.2.14.5.1 Density.** The minimum density of foam plastics used in signs shall not be less than 320 kg/m<sup>3</sup>.

**2B.2.14.5.2 Thickness.** The thickness of foam plastic signs shall not be greater than 12.7 mm.

**2B.2.15 Civil defense access to equipment.** Rooms or areas containing controls for air-conditioning systems, automatic fire-extinguishing systems or other detection, suppression or control elements shall be identified for use by the fire - Civil

Defence.

### SECTION 2B.3 HIGH-RISE BUILDINGS

- 2B.3.1 Applicability.** The provisions of this section shall apply to buildings having occupied floors located more than 23 m above the lowest level of Civil Defence vehicle access.
- Exception:** The provisions of this section shall not apply to the following buildings and structures:
1. Airport traffic control towers in accordance with Section 2B.12.
  2. Open parking garages in accordance with Section 2B.6.3.
  3. Buildings with an occupancy in Group A-5 in accordance with Section 2A3.1.
  4. Low-hazard special industrial occupancies in accordance with Section 3.3.1.2.
  5. Buildings with an occupancy in Group H-1, H-2 or H-3 in accordance with Section 2B.15.
- 2B.3.2 Automatic sprinkler system.** Buildings and structures shall be equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 and a secondary water supply where required by Section 7.3.3.5.2.
- Exception:** An automatic sprinkler system shall not be required in spaces or areas of:
1. Open parking garages in accordance with Section 2B.6.3.
  2. Telecommunications equipment buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided that those spaces or areas are equipped throughout with an automatic fire detection system in accordance with Section 7.7.2 and are separated from the remainder of the building with fire barriers consisting of 1 hour fire-resistance-rated walls and 2 hours fire-resistance-rated floor/ceiling assemblies.
- 2B.3.3 Reduction in fire-resistance rating.** The fire-resistance-rating reductions listed in Sections 2B.3.3.1 and 2B.3.3.2 shall be allowed in buildings that have sprinkler control valves equipped with supervisory initiating devices and water-flow initiating devices for each floor.
- 2B.3.3.1 Type of construction.** The following reductions in the minimum construction type allowed in Table 4A.1 shall be allowed as provided in Section 2B.3.3:
1. Type IA construction shall be allowed to be reduced to Type IB.
  2. In other than Groups F-1, M and S-1, Type IB construction shall be allowed to be reduced to Type IIA.
  3. The height and area limitations of the reduced construction type shall be allowed to be the same as for the original construction type.
- 2B.3.3.2 Shaft enclosures.** The required fire-resistance rating of the fire barrier walls enclosing vertical shafts, other than exit enclosures and elevator hoistway enclosures, shall be reduced to 1 hour where automatic sprinklers are installed within the shafts at the top and at alternate floor levels.
- 2B.3.4 Emergency escape and rescue.** Emergency escape and rescue openings required by Section 8.25 are not required.
- 2B.3.5 Automatic fire detection.** Smoke detection shall be provided in accordance with Section 7.7.2.12.1.



- 2B.3.6 Emergency voice/alarm communication systems.** An emergency voice/alarm communication system shall be provided in accordance with Section 7.7.2.12.2.
- 2B.3.7 Fire civil defense communications system.** A two-way fire civil defense communications system shall be provided for Civil Defence use in accordance with Section 7.7.2.12.3.
- 2B.3.8 Fire command.** A fire command center complying with Section 7.11 shall be provided in a location approved by the Civil Defence.
- 2B.3.9 Elevators.** Elevator operation and installation shall be in accordance with SBC 501.
- 2B.3.10 Standby power.** A standby power system complying with SBC 401 shall be provided for standby power loads specified in Section 2B.3.10.2.
- 2B.3.10.1 Special requirements for standby power systems.** If the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with 2 hours fire-resistance-rated fire barrier assemblies. System supervision with manual start and transfer features shall be provided at the fire command center.
- 2B.3.10.2 Standby power loads.** The following are classified as standby power loads:
1. Power and lighting for the fire command center required by Section 2B.3.8;
  2. Electrically powered fire pumps;
  3. Ventilation and automatic fire detection equipment for smokeproof enclosures.
- Standby power shall be provided for elevators in accordance with SBC 501.
- 2B.3.11 Emergency power systems.** An emergency power system complying with SBC 401 shall be provided for emergency power loads specified in Section 2B.3.11.1.
- 2B.3.11.1 Emergency power loads.** The following are classified as emergency power loads:
1. Exit signs and means of egress illumination required by Chapter 8;
  2. Elevator car lighting;
  3. Emergency voice/alarm communications systems;
  4. Automatic fire detection systems; and
  5. Fire alarm systems.
- 2B.3.12 Stairway door operation.** Stairway doors other than the exit discharge doors shall be permitted to be locked from stairway side. Stairway doors that are locked from the stairway side shall be capable of being unlocked simultaneously without unlatching upon a signal from the fire command center.
- 2B.3.12.1 Stairway communications system.** A telephone or other two-way communications system connected to an approved constantly attended station shall be provided at not less than every fifth floor in each required stairway where the doors to the stairway are locked.
- 2B.3.13 Smokeproof exit enclosures.** Every required stairway serving floors more than 23 m above the lowest level of civil defense vehicle access shall comply with Sections 7.9.20 and 8.19.1.8.
- 2B.3.14 Seismic considerations.** For seismic considerations, see SBC 301.

## SECTION 2B.4

### ATRIUMS

**2B.4.1 General.** Vertical openings meeting the requirements of this section are not required to be enclosed in other than Group H occupancies.

**2B.4.1.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**ATRIUM.** An opening connecting two or more stories other than enclosed stairways, elevators, hoistways, escalators, plumbing, electrical, air-conditioning or other equipment, which is closed at the top and not defined as a mall. Stories, as used in this definition, do not include balconies within assembly groups or mezzanines that comply with Section 3.5.

**2B.4.2 Use.** The floor of the atrium shall not be used for other than low fire hazard uses and only approved materials and decorations in accordance with these code requirements shall be used in the atrium space.

**Exception:** The atrium floor area is permitted to be used for any approved use where the individual space is provided with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

**2B.4.3 Automatic sprinkler protection.** An approved automatic sprinkler system shall be installed throughout the entire building.

**Exceptions:**

1. That area of a building adjacent to or above the atrium need not be sprinklered provided that portion of the building is separated from the atrium portion by a 2 hours fire barrier wall or horizontal assembly or both.
2. Where the ceiling of the atrium is more than 17 m above the floor, sprinkler protection at the ceiling of the atrium is not required.

**2B.4.4 Smoke control.** A smoke control system shall be installed in accordance with Section 7.9.

**Exceptions:**

1. Smoke control is not required for floor openings meeting the requirements of Section 4B.7.2, Exception 2, 7, 8 or 9.
2. Smoke control is not required for floor openings meeting the requirements of Section 8.19.1, Exception 8 or 9.

**2B.4.5 Enclosure of atriums.** Atrium spaces shall be separated from adjacent spaces by a 1 hour fire barrier wall.

**Exceptions:**

1. A glass wall forming a smoke partition where automatic sprinklers are spaced 1.8 m or less along both sides of the separation wall, or on the room side only if there is not a walkway on the atrium side, and between 102 mm and 305 mm away from the glass and so designed that the entire surface of the glass is wet upon activation of the sprinkler system. The glass shall be installed in a gasketed frame so that the framing system deflects without breaking (loading) the glass before the sprinkler system operates.
2. A glass-block wall assembly in accordance with SBC 305 and having a  $\frac{3}{4}$  hour fire protection rating.
3. The adjacent spaces of any three floors of the atrium shall not be required to be separated from the atrium where such spaces are included in computing the

atrium volume for the design of the smoke control system.

**2B.4.6 Standby power.** Equipment required to provide smoke control shall be connected to a standby power system in accordance with Section 7.9.11.

**2B.4.7 Interior finish.** The interior finish of walls and ceilings of the atrium shall not be less than Class B with no reduction in class for sprinkler protection.

**2B.4.8 Travel distance.** In other than the lowest level of the atrium, where the required means of egress is through the atrium space, the portion of exit access travel distance within the atrium space shall not exceed 61 m.

## SECTION 2B.5 UNDERGROUND BUILDINGS

**2B.5.1 General.** The provisions of this section apply to building spaces having a floor level used for human occupancy more than 9.1 m below the lowest level of exit discharge.

**Exceptions:**

1. One- and two-family dwellings, sprinklered in accordance with Section 7.3.3.1.3.
2. Parking garages with automatic fire suppression systems in compliance with Section 2B.5.3.
3. Fixed guideway transit systems.
4. Grandstands, bleachers, stadiums, arenas and similar facilities.
5. Where the lowest story is the only story that would qualify the building as an underground building and has an area not exceeding 139 m<sup>2</sup> and has an occupant load less than 10.

**2B.5.2 Construction requirements.** The underground portion of the building shall be of Type I construction.

**2B.5.3 Automatic sprinkler system.** The highest level of exit discharge serving the underground portions of the building and all levels below shall be equipped with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1. Water-flow switches and control valves shall be supervised in accordance with Section 7.3.4.

**2B.5.4 Compartmentation.** Compartmentation shall be in accordance with Sections 2B.5.4.1 through 2B.5.4.3.

**2B.5.4.1 Number of compartments.** A building having a floor level more than 18.3 m below the lowest level of exit discharge shall be divided into a minimum of two compartments of approximately equal size. Such compartmentation shall extend through the highest level of exit discharge serving the underground portions of the building and all levels below.

**Exception:** The lowest story need not be compartmented where the area does not exceed 139 m<sup>2</sup> and has an occupant load of less than 10.

**2B.5.4.2 Smoke barrier penetration.** The separation between the two compartments shall be of minimum 1 hour fire barrier wall construction that shall extend from floor slab to floor deck above. Openings between the two compartments shall be limited to plumbing and electrical piping and conduit penetrations fire stopped in accordance with Section 4B.12. Doorways shall be protected by door assemblies that are automatic-closing by smoke detection in accordance with Section 4B.15.3



and shall be provided with gasketing and a drop sill to minimize smoke leakage. Where provided, each compartment shall have an air supply and an exhaust system independent of the other compartments.

- 2B.5.4.3 Elevators.** Where elevators are provided, each compartment shall have direct access to an elevator. Where an elevator serves more than one compartment, an elevator lobby shall be provided and shall be separated from each compartment by a 1 hour fire barrier wall. Doors shall be gasketed, have a drop sill, and be automatic-closing by smoke detection installed in accordance with Section 7.7.10.
- 2B.5.5 Smoke control system.** A smoke control system shall be provided in accordance with Sections 2B.5.5.1 and 2B.5.5.2.
- 2B.5.5.1 Control system.** A smoke control system is required to control the migration of products of combustion in accordance with Section 7.9 and the provisions of this section. Smoke control shall restrict movement of smoke to the general area of fire origin and maintain means of egress in a usable condition.
- 2B.5.5.2 Smoke exhaust system.** Where compartmentation is required, each compartment shall have an independent smoke control system. The system shall be automatically activated and capable of manual operation in accordance with Section 7.7.2.18.
- 2B.5.6 Fire alarm systems.** A fire alarm system shall be provided where required by Section 7.7.2.19.
- 2B.5.7 Public address.** A public address system shall be provided where required by Section 7.7.2.19.1.
- 2B.5.8 Means of egress.** Means of egress shall be in accordance with Sections 2B.5.8.1 and 2B.5.8.2.
- 2B.5.8.1 Number of exits.** Each floor level shall be provided with a minimum of two exits. Where compartmentation is required by Section 2B.5.4, each compartment shall have a minimum of one exit and shall also have an exit access doorway into the adjoining compartment.
- 2B.5.8.2 Smokeproof enclosure.** Every required stairway serving floor levels more than 9.1 m below its level of exit discharge shall comply with the requirements for a smokeproof enclosure as provided in Section 8.19.1.8.
- 2B.5.9 Standby power.** A standby power system complying with SBC 401 shall be provided standby power loads specified in Section 2B.5.9.1.
- 2B.5.9.1 Standby power loads.** The following loads are classified as standby power loads.
1. Smoke control system.
  2. Ventilation and automatic fire detection equipment for smokeproof enclosures.
  3. Fire pumps.
- Standby power shall be provided for elevators in accordance with SBC 501.
- 2B.5.9.2 Pick-up time.** The standby power system shall pick up its connected loads within 60 seconds of failure of the normal power supply.
- 2B.5.10 Emergency power.** An emergency power system complying with SBC 401 shall be provided for emergency power loads specified in Section 2B.5.10.1.
- 2B.5.10.1 Emergency power loads.** The following loads are classified as emergency power loads:
1. Emergency voice/alarm communications systems.
  2. Fire alarm systems.

3. Automatic fire detection systems.
4. Elevator car lighting.
5. Means of egress and exit sign illumination as required by Chapter 8.

**2B.5.11 Standpipe system.** The underground building shall be provided throughout with a standpipe system in accordance with Section 7.5.

## SECTION 2B.6 MOTOR-VEHICLE-RELATED OCCUPANCIES

**2B.6.1 Private garages and carports.**

**2B.6.1.1 Classification.** Buildings or parts of buildings classified as Group U occupancies because of the use or character of the occupancy shall not exceed 93 m<sup>2</sup> in area or one story in height except as provided in Section 2B.6.1.2. Any building or portion thereof that exceeds the limitations specified in this section shall be classified in the occupancy group other than Group U that it most nearly resembles.

**2B.6.1.2 Area increase.** Group U occupancies used for the storage of private or pleasure-type motor vehicles where no repair work is done or fuel dispensed are permitted to be 279 m<sup>2</sup>, when the following provisions are met:

1. For a mixed occupancy building, the exterior wall and opening protection for the Group U portion of the building shall be as required for the major occupancy of the building. For such mixed occupancy building, the allowable floor area of the building shall be as permitted for the major occupancy contained therein.

2. For a building containing only Group U occupancy, the exterior wall and opening protection shall be as required for a Group R-1 or R-2 occupancy. More than one 279 m<sup>2</sup> Group U occupancy shall be permitted to be in the same building, provided each 279 m<sup>2</sup> area is separated by fire walls complying with Section 4B.6.

**2B.6.1.3 Garages and carports.** Carports shall be open on at least two sides. Carport floor surfaces shall be of approved noncombustible material. Carports not open on at least two sides shall be considered a garage and shall comply with the provisions of this section for garages.

**Exception:** Asphalt surfaces shall be permitted at ground level in carports. The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

**2B.6.1.4 Separation.** Separations shall comply with the following:

1. The private garage shall be separated from the dwelling unit and its attic area by means of a minimum 12.7 mm gypsum board applied to the garage side. Garages beneath habitable rooms shall be separated from all habitable rooms above by not less than 16 mm Type X gypsum board or equivalent. Door openings between a private garage and the dwelling unit shall be equipped with either solid wood doors, or solid or honeycomb core steel doors not less than 35 mm thick, or doors in compliance with Section 4B.15.3.3. Openings from a private garage directly into a room used for sleeping purposes shall not be permitted.
2. Ducts in a private garage and ducts penetrating the walls or ceilings separating the dwelling unit from the garage shall be constructed of a minimum 0.48 mm sheet steel and shall have no openings into the garage.
3. A separation is not required between a Group R-3 and U carport provided the carport is entirely open on two or more sides and there are not enclosed areas

above.

**2B.6.2 Parking garages.**

**2B.6.2.1 Classification.** Parking garages shall be classified as open, as defined in Section 2B.6.3, or enclosed and shall meet the appropriate criteria in Section 2B.6.4. Also see Section 3.8 for special provisions for parking garages.

**2B.6.2.2 Clear height.** The clear height of each floor level in vehicle and pedestrian traffic areas shall not be less than 2.1 m. Vehicle and pedestrian areas accommodating van-accessible parking required by Section 9.6.5 of the SBC 201 shall conform to ICC A117.1.

**2B.6.2.3 Guards.** Guards shall be provided in accordance with Section 8.12 at exterior and interior vertical openings on floor and roof areas where vehicles are parked or moved and where the vertical distance to the ground or surface directly below exceeds 762 mm.

**2B.6.2.4 Vehicle barriers.** Parking areas shall be provided with exterior or interior walls or vehicle barriers, except at pedestrian or vehicular accesses, designed in accordance with SBC 301. Vehicle barriers not less than 607 mm high shall be placed at the ends of drive lanes, at the end of parking spaces where the difference in adjacent floor elevation is greater than 305 mm.

**2B.6.2.5 Ramps.** Vehicle ramps shall not serve as an exit element.

**2B.6.2.6 Floor surface.** Parking surfaces shall be of concrete or similar noncombustible and nonabsorbent materials.

**Exception:** Asphalt parking surfaces are permitted at ground level.

The area of floor used for parking of automobiles or other vehicles shall be sloped to facilitate the movement of liquids to a drain or toward the main vehicle entry doorway.

**2B.6.2.7 Mixed separation.** Parking garages shall be separated from other occupancies in accordance with Section 2A.2.1.1.

**2B.6.2.8 Special hazards.** Connection of a parking garage with any room in which there is a fuel-fired appliance shall be by means of a vestibule providing a two-doorway separation.

**Exception:** A single door shall be allowed provided the sources of ignition in the appliance are at least 457 mm above the floor.

**2B.6.2.9 Attached to rooms.** Openings from a parking garage directly into a room used for sleeping purposes shall not be permitted.

**2B.6.3 Open parking garages.**

**2B.6.3.1 Scope.** Except where specific provisions are made in the following subsections, other requirements of these code requirements shall apply.

**2B.6.3.2 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**MECHANICAL-ACCESS OPEN PARKING GARAGES.** Open parking garages employing parking machines, lifts, elevators or other mechanical devices for vehicles moving from and to street level and in which public occupancy is prohibited above the street level.

**OPEN PARKING GARAGE.** A structure or portion of a structure with the openings as described in Section 2B.6.3.3.1 on two or more sides that is used for the parking or storage of private motor vehicles as described in Section 2B.6.3.4.

**RAMP-ACCESS OPEN PARKING GARAGES.** Open parking garages

employing a series of continuously rising floors or a series of interconnecting ramps between floors permitting the movement of vehicles under their own power from and to the street level.

**2B.6.3.3 Construction.** Open parking garages shall be of Type I, II or IV construction. Open parking garages shall meet the design requirements of SBC 301. For vehicle barriers, see Section 2B.6.2.4.

**2B.6.3.3.1 Openings.** For natural ventilation purposes, the exterior side of the structure shall have uniformly distributed openings on two or more sides. The area of such openings in exterior walls on a tier must be at least 20 percent of the total perimeter wall area of each tier. The aggregate length of the openings considered to be providing natural ventilation shall constitute a minimum of 40 percent of the perimeter of the tier. Interior walls shall be at least 20 percent open with uniformly distributed openings.

**Exception:** Openings are not required to be distributed over 40 percent of the building perimeter where the required openings are uniformly distributed over two opposing sides of the building.

**2B.6.3.4 Uses.** Mixed uses shall be allowed in the same building as an open parking garage subject to the provisions of Sections 2A.2.3, 2B.2.7.1, 2B.6.3.13, 3.8.3, 3.8.5 and 3.8.8

**2B.6.3.5 Area and height.** Area and height of open parking garages shall be limited as set forth in Chapter 3 for Group S-2 occupancies and as further provided for in Section 2A.2.3.

**2B.6.3.5.1 Single use.** When the open parking garage is used exclusively for the parking or storage of private motor vehicles, with no other uses in the building, the area and height shall be permitted to comply with Table 2B.6.3.5, along with increases allowed by Section 2B.6.3.6.

**Exception:** The grade-level tier is permitted to contain an office, waiting and toilet rooms having a total combined area of not more than 93 m<sup>2</sup>. Such area need not be separated from the open parking garage.

In open parking garages having a spiral or sloping floor, the horizontal projection of the structure at any cross section shall not exceed the allowable area per parking tier. In the case of an open parking garage having a continuous spiral floor, each 2.9 m of height, or portion thereof, shall be considered a tier.

The clear height of a parking tier shall not be less than 2.1 m, except that a lower clear height is permitted in mechanical-access open parking garages where approved by the building official.

**TABLE 2B.6.3.5  
OPEN PARKING GARAGES AREA AND HEIGHT**

TYPE OF CONSTRUCTION	AREA PER TIER (square meters)	HEIGHT (in tiers)		
		Ramp access	Mechanical access	
			Automatic sprinkler system	
			No	Yes
IA	Unlimited	Unlimited	Unlimited	Unlimited
IB	Unlimited	12 tiers	12 tiers	18 tiers
IIA	4,645	10 tiers	10 tiers	15 tiers
IIB	4,645	8 tiers	8 tiers	12 tiers
IV	4,645	4 tiers	4 tiers	4 tiers

- 2B.6.3.6 Area and height increases.** The allowable area and height of open parking garages shall be increased in accordance with the provisions of this section. Garages with sides open on three-fourths of the building perimeter are permitted to be increased by 25 percent in area and one tier in height. Garages with sides open around the entire building perimeter are permitted to be increased 50 percent in area and one tier in height. For a side to be considered open under the above provisions, the total area of openings along the side shall not be less than 50 percent of the interior area of the side at each tier, and such openings shall be equally distributed along the length of the tier.
- Allowable tier areas in Table 2B.6.3.5 shall be increased for open parking garages constructed to heights less than the table maximum. The gross tier area of the garage shall not exceed that permitted for the higher structure. At least three sides of each such larger tier shall have continuous horizontal openings not less than 762 mm in clear height extending for at least 80 percent of the length of the sides, and no part of such larger tier shall be more than 61 m horizontally from such an opening. In addition, each such opening shall face a street or yard accessible to a street with a width of at least 9.1 m for the full length of the opening, and standpipes shall be provided in each such tier.
- Open parking garages of Type IB and II construction, with all sides open, shall be unlimited in allowable area where the height does not exceed 23 m. For a side to be considered open, the total area of openings along the side shall not be less than 50 percent of the interior area of the side at each tier, and such openings shall be equally distributed along the length of the tier. All portions of tiers shall be within 61 m horizontally from such openings.
- 2B.6.3.7 Location on property.** Exterior walls and openings in exterior walls shall comply with Tables 4A.1 and 4A.2. The distance from an adjacent property line shall be determined in accordance with Table 4A.2 and Section 4B.4.
- 2B.6.3.8 Means of egress.** Where persons other than parking attendants are permitted, open parking garages shall meet the means of egress requirements of Chapter 8 where no persons other than parking attendants are permitted, there shall not be less than two 914 mm exit stairways. Lifts shall be permitted to be installed for use of employees only, provided they are completely enclosed by noncombustible materials.
- 2B.6.3.9 Standpipes.** Standpipes shall be installed where required by the provisions of Chapter 7.
- 2B.6.3.10 Sprinkler systems.** Where required by other provisions or these code requirements, automatic sprinkler systems and standpipes shall be installed in accordance with the provisions of Chapter 7.
- 2B.6.3.11 Enclosure of vertical openings.** Enclosure shall not be required for vertical openings except as specified in Section 2B.6.3.8.
- 2B.6.3.12 Ventilation.** Ventilation, other than the percentage of openings specified in Section 2B.6.3.3.1, shall not be required.
- 2B.6.3.13 Prohibitions.** The following uses and alterations are not permitted:
1. Vehicle repair work.
  2. Parking of buses, trucks and similar vehicles.
  3. Partial or complete closing of required openings in exterior walls by tarpaulins or any other means.
  4. Dispensing of fuel.
- 2B.6.4 Enclosed parking garages.** Enclosed vehicle parking garages and portions thereof that do not meet the definition of open parking garages shall be limited to the



allowable heights and areas specified in Table 3.3. Roof parking is permitted.

**2B.6.4.2 Ventilation.** A mechanical ventilation system shall be provided in accordance with the SBC 501.

**2B.6.5 Motor fuel-dispensing facilities.**

**2B.6.5.1 Construction.** Motor fuel-dispensing facilities shall be constructed in accordance with these code requirements and this section.

**2B.6.5.2 Canopies.** Canopies under which fuels are dispensed shall have a clear, unobstructed height of not less than 4.1 m to the lowest projecting element in the vehicle drive-through area. Canopies and their supports over pumps shall be of non-combustible materials, fire-retardant-treated wood complying with Chapter 4, wood of Type IV sizes or of construction providing 1 hour fire resistance. Combustible materials used in or on a canopy shall comply with one of the following:

1. Shielded from the pumps by a noncombustible element of the canopy, or wood of Type IV sizes;
2. Plastics covered by aluminum facing having a minimum thickness of 0.30 mm or corrosion-resistant steel having a minimum base metal thickness of 0.41 mm. The plastic shall have a flame spread index of 25 or less and a smoke-developed index of 450 or less when tested in the form intended for use in accordance with ASTM E 84 and a self-ignition temperature of 343°C or greater when tested in accordance with ASTM D 1929; or
3. Panels constructed of light-transmitting plastic materials shall be permitted to be installed in canopies erected over motor vehicle fuel-dispensing station fuel dispensers, provided the panels are located at least 3.1 m from any building on the same property and face yards or streets not less than 12.2 m in width on the other sides. The aggregate areas of plastics shall not exceed 93 m<sup>2</sup>. The maximum area of any individual panel shall not exceed 9.3 m<sup>2</sup>.

**2B.6.6 Repair garages.**

**2B.6.6.1 General.** Repair garages shall be constructed in accordance with these code requirements and this section. This occupancy shall not include motor fuel-dispensing facilities, as regulated in Section 2B.6.5.

**2B.6.6.2 Mixed uses.** Mixed uses shall be allowed in the same building as a repair garage subject to the provisions of Section 2A.2.3.

**2B.6.6.3 Ventilation.** Repair garages shall be mechanically ventilated in accordance with the SBC 501. The ventilation system shall be controlled at the entrance to the garage.

**2B.6.6.4 Floor surface.** Repair garage floors shall be of concrete or similar noncombustible and nonabsorbent materials.

**Exception:** Slip-resistant, nonabsorbent, interior floor finishes having a critical radiant flux not more than 0.45 W/cm<sup>2</sup>, as determined by NFPA 253, shall be permitted.

**2B.6.6.5 Heating equipment.** Heating equipment shall be installed in accordance with the SBC 501.

**2B.6.6.6 Gas detection system.** Repair garages used for repair of vehicles fueled by non-odorized gases, such as hydrogen and non-odorized LNG, shall be provided with an approved flammable gas-detection system.

**2B.6.6.6.1 System design.** The flammable gas-detection system shall be calibrated to the types of fuels or gases used by vehicles to be repaired. The gas detection system shall be designed to activate when the level of flammable gas exceeds 25 percent of the lower explosive limit. Gas detection shall also be provided in lubrication or

chassis repair pits of garages used for repairing non-odorized LNG-fueled vehicles.

**2B.6.6.6.2 Operation.** Activation of the gas detection system shall result in all of the following:

1. Initiation of distinct audible and visual alarm signals in the repair garage.
2. Deactivation of all heating systems located in the repair garage.
3. Activation of the mechanical ventilation system, where the system is interlocked with gas detection.

**2B.6.6.6.3 Failure of the gas detection system.** Failure of the gas detection system shall result in the deactivation of the heating system, activation of the mechanical ventilation system when the system is interlocked with the gas detection system and cause a trouble signal to sound in an approved location.

## SECTION 2B.7 GROUP I-2

**2B.7.1 General.** Occupancies in Group I-2 shall comply with the provisions of this section and other applicable provisions of these code requirements.

**2B.7.2 Corridors.** Corridors in occupancies in Group I-2 shall be continuous to the exits and separated from other areas in accordance with Section 2B.7.3 except spaces conforming to Sections 2B.7.2.1 through 2B.7.2.4.

**2B.7.2.1 Spaces of unlimited area.** Waiting areas and similar spaces constructed as required for corridors shall be permitted to be open to a corridor, only where all of the following criteria are met:

1. The spaces are not occupied for patient sleeping units, treatment rooms, hazardous or incidental use areas as defined in Section 2A.2.1.1.
2. The open space is protected by an automatic fire detection system installed in accordance with Section 7.7.
3. The corridors, onto which the spaces open, in the same smoke compartment, are protected by an automatic fire detection system installed in accordance with Section 7.7, or the smoke compartment in which the spaces are located is equipped throughout with quick-response sprinklers in accordance with Section 7.3.3.2.

4. The space is arranged so as not to obstruct access to the required exits.

**2B.7.2.2 Nurses' stations.** Spaces for doctors' and nurses' charting, communications and related clerical areas shall be permitted to be open to the corridor, when such spaces are constructed as required for corridors.

**2B.7.2.3 Mental health treatment areas.** Areas wherein mental health patients who are not capable of self-preservation are housed, or group meeting or multipurpose therapeutic spaces other than incidental use areas as defined in Section 2A.2.1.1, under continuous supervision by facility staff, shall be permitted to be open to the corridor, where the following criteria are met:

1. Each area does not exceed 140 m<sup>2</sup>.
2. The area is located to permit supervision by the facility staff.
3. The area is arranged so as not to obstruct any access to the required exits.
4. The area is equipped with an automatic fire detection system installed in accordance with Section 7.7.2.
5. Not more than one such space is permitted in any one smoke compartment.
6. The walls and ceilings of the space are constructed as required for corridors.

**2B.7.2.4 Gift shops.** Gift shops less than 46.5 m<sup>2</sup> in area shall be permitted to be open to the corridor provided the gift shop and storage areas are fully sprinklered and

storage areas are protected in accordance with Section 2A.2.1.1.

- 2B.7.3 Corridor walls.** Corridor walls shall be constructed as smoke partitions.
- 2B.7.3.1 Corridor doors.** Corridor doors, other than those in a wall required to be rated by Section 2A.2.1.1 or for the enclosure of a vertical opening or an exit, shall not have a required fire protection rating and shall not be required to be equipped with self-closing or automatic-closing devices, but shall provide an effective barrier to limit the transfer of smoke and shall be equipped with positive latching. Roller latches are not permitted. Other doors shall conform to Section 4B.15.3.
- 2B.7.3.2 Locking devices.** Locking devices that restrict access to the patient room from the corridor, and that are operable only by staff from the corridor side, shall not restrict the means of egress from the patient room except for patient rooms in mental health facilities.
- 2B.7.4 Smoke barriers.** Smoke barriers shall be provided to subdivide every story used by patients for sleeping or treatment and to divide other stories with an occupant load of 50 or more persons, into at least two smoke compartments. Such stories shall be divided into smoke compartments with an area of not more than 2,092 m<sup>2</sup> and the travel distance from any point in a smoke compartment to a smoke barrier door shall not exceed 61 m. The smoke barrier shall be in accordance with Section 4B.9.
- 2B.7.4.1 Refuge area.** At least 2.8 m<sup>2</sup> per patient shall be provided within the aggregate area of corridors, patient rooms, treatment rooms, lounge or dining areas and other low-hazard areas on each side of each smoke barrier. On floors not housing patients confined to a bed or litter, at least 0.56 m<sup>2</sup> per occupant shall be provided on each side of each smoke barrier for the total number of occupants in adjoining smoke compartments.
- 2B.7.4.2 Independent egress.** A means of egress shall be provided from each smoke compartment created by smoke barriers without having to return through the smoke compartment from which means of egress originated.
- 2B.7.5 Automatic sprinkler system.** Smoke compartments containing patient sleeping units shall be equipped throughout with an automatic fire sprinkler system in accordance with Section 7.3.3.1.1. The smoke compartments shall be equipped with approved quick-response or residential sprinklers in accordance with Section 7.3.3.2.
- 2B.7.6 Automatic fire detection.** Corridors in nursing homes (both intermediate-care and skilled nursing facilities), detoxification facilities and spaces permitted to be open to corridors by Section 2B.7.2 shall be protected by an automatic fire detection system installed in accordance with Section 7.7.
- Exceptions:**
1. Corridor smoke detection is not required where patient sleeping units are provided with smoke detectors that comply with UL 268. Such detectors shall provide a visual display on the corridor side of each patient sleeping unit and an audible and visual alarm at the nursing station attending each unit.
  2. Corridor smoke detection is not required where patient sleeping unit doors are equipped with automatic door-closing devices with integral smoke detectors on the unit sides installed in accordance with their listing, provided that the integral detectors perform the required alerting function.
- 2B.7.7 Secured yards.** Grounds are permitted to be fenced and gates therein are permitted



to be equipped with locks, provided that safe dispersal areas having 2.8 m<sup>2</sup> for bed and litter patients and 0.56 m<sup>2</sup> for ambulatory patients and other occupants are located between the building and the fence. Such provided safe dispersal areas shall not be located less than 15.3 m from the building they serve.

## SECTION 2B.8 GROUP I-3

- 2B.8.1 General.** Occupancies in Group I-3 shall comply with the provisions of this section and other applicable provisions of these code requirements (see Section 2A.8.4).
- 2B.8.2 Mixed occupancies.** Portions of buildings with an occupancy in Group I-3 that are classified as a different occupancy shall meet the applicable requirements of these code requirements for such occupancies. Where security operations necessitate the locking of required means of egress, provisions shall be made for the release of occupants at all times.  
Means of egress from detention and correctional occupancies that traverse other use areas shall, as a minimum, conform to requirements for detention and correctional occupancies.  
**Exception:** It is permissible to exit through a horizontal exit into other contiguous occupancies that do not conform to detention and correctional occupancy egress provisions but that do comply with requirements set forth in the appropriate occupancy, as long as the occupancy is not a high-hazard use.
- 2B.8.3 Means of egress.** Except as modified or as provided for in this section, the provisions of Chapter 8 shall apply.
- 2B.8.3.1 Door width.** Doors to resident sleeping units shall have a clear width of not less than 711 mm.
- 2B.8.3.2 Sliding doors.** Where doors in a means of egress are of the horizontal-sliding type, the force to slide the door to its fully open position shall not exceed 220 N with a perpendicular force against the door of 220 N.
- 2B.8.3.3 Spiral stairs.** Spiral stairs that conform to the requirements of Section 8.3.3.3.9 are permitted for access to and between staff locations.
- 2B.8.3.4 Exit discharge.** Exits are permitted to discharge into a fenced or walled courtyard. Enclosed yards or courts shall be of a size to accommodate all occupants, a minimum of 15.3 m from the building with a net area of 1.4 m<sup>2</sup> per person.
- 2B.8.3.5 Sallyports.** A sallyport shall be permitted in a means of egress where there are provisions for continuous and unobstructed passage through the sallyport during an emergency egress condition.
- 2B.8.3.6 Vertical exit enclosures.** One of the required vertical exit enclosures in each building shall be permitted to have glazing installed in doors and interior walls at each landing level providing access to the enclosure, provided that the following conditions are met:
1. The vertical exit enclosure shall not serve more than four floor levels.
  2. Vertical exit enclosure doors shall not be less than 3/4-hour fire doors complying with Section 4B.14.2.
  3. The total area of glazing at each floor level shall not exceed 3.23 m<sup>2</sup> and individual panels of glazing shall not exceed 0.84 m<sup>2</sup>.
  4. The glazing shall be protected on both sides by an automatic fire sprinkler system. The sprinkler system shall be designed to wet completely the entire surface of any glazing affected by fire when actuated.

5. The glazing shall be in a gasketed frame and installed in such a manner that the framing system will deflect without breaking (loading) the glass before the sprinkler system operates.
6. Obstructions, such as curtain rods, drapery traverse rods, curtains, drapes or similar materials shall not be installed between the automatic sprinklers and the glazing.

**2B.8.4 Locks.** Egress doors are permitted to be locked in accordance with the applicable use condition. Doors from an area of refuge to the exterior are permitted to be locked with a key in lieu of locking methods described in Section 2B.8.4.1. The keys to unlock the exterior doors shall be available at all times and the locks shall be operable from both sides of the door.

**2B.8.4.1 Remote release.** Remote release of locks on doors in a means of egress shall be provided with reliable means of operation, remote from the resident living areas, to release locks on all required doors. In Occupancy Conditions 3 or 4, the arrangement, accessibility and security of the release mechanism(s) required for egress shall be such that with the minimum available staff at any time, the lock mechanisms are capable of being released within 2 minutes.

**Exception:** Provisions for remote locking and unlocking of occupied rooms in Occupancy Condition 4 are not required provided that not more than 10 locks are necessary to be unlocked in order to move occupants from one smoke compartment to a refuge area within 3 minutes. The opening of necessary locks shall be accomplished with not more than two separate keys.

**2B.8.4.2 Power-operated doors and locks.** Power-operated sliding doors or power-operated locks for swinging doors shall be operable by a manual release mechanism at the door, and either emergency power or a remote mechanical operating release shall be provided.

**Exception:** Emergency power is not required in facilities with 10 locks or less complying with the exception to Section 2B.8.4.1.

**2B.8.4.3 Redundant operation.** Remote release, mechanically operated sliding doors or remote release, mechanically operated locks shall be provided with a mechanically operated release mechanism at each door, or shall be provided with a redundant remote release control.

**2B.8.4.4 Relock capability.** Doors remotely unlocked under emergency conditions shall not automatically relock when closed unless specific action is taken at the remote location to enable doors to relock.

**2B.8.5 Vertical openings.** Vertical openings shall be enclosed in accordance with Section 4B.7.

**Exception:** A floor opening between floor levels of residential housing areas is permitted without enclosure protection between the levels, provided that both of the following conditions are met:

1. The entire normally occupied areas so interconnected are open and unobstructed so as to enable observation of the areas by supervisory personnel.
2. Means of egress capacity is sufficient to provide simultaneous egress for all occupants from all interconnected levels and areas.

The height difference between the highest and lowest finished floor levels shall not exceed 70 m. Each story, considered separately, has at least one-half of its individual required means of egress capacity provided by exits leading directly out of that story without traversing another story within the interconnected area.

- 2B.8.6 Smoke barrier.** Occupancies in Group I-3 shall have smoke barriers complying with Section 4B.9 to divide every story occupied by residents for sleeping, or any other story having an occupant load of 50 or more persons, into at least two smoke compartments.
- Exception:** Spaces having direct exit to one of the following, provided that the locking arrangement of the doors involved complies with the requirements for doors at the compartment barrier for the use condition involved:
1. A public way.
  2. A building separated from the resident housing area by a 2 hours fire-resistance-rated assembly or 15.3 m of open space.
  3. A secured yard or court having a holding space 15.3 m from the housing area that provides 0.56 m<sup>2</sup> or more of refuge area per occupant, including residents, staff and visitors.
- 2B.8.6.1 Smoke compartments.** The maximum number of residents in any smoke compartment shall be 200. The travel distance to a door in a smoke barrier from any room door required as exit access shall not exceed 46 m. The travel distance to a door in a smoke barrier from any point in a room shall not exceed 61 m.
- 2B.8.6.2 Refuge area.** At least 0.56 m<sup>2</sup> per occupant shall be provided on each side of each smoke barrier for the total number of occupants in adjoining smoke compartments. This space shall be readily available wherever the occupants are moved across the smoke barrier in a fire emergency.
- 2B.8.6.3 Independent egress.** A means of egress shall be provided from each smoke compartment created by smoke barriers without having to return through the smoke compartment from which means of egress originates.
- 2B.8.7 Subdivision of resident housing areas.** Sleeping areas and any contiguous day room, group activity space or other common spaces where residents are housed shall be separated from other spaces in accordance with Sections 2B.8.7.1 through 2B.8.7.4.
- 2B.8.7.1 Occupancy Conditions 3 and 4.** Each sleeping area in Occupancy Conditions 3 and 4 shall be separated from the adjacent common spaces by a smoke-tight partition where the travel distance from the sleeping area through the common space to the exit access corridor exceeds 15.3 m.
- 2B.8.7.2 Occupancy Condition 5.** Each sleeping area in Occupancy Condition 5 shall be separated from adjacent sleeping areas, corridors and common spaces by a smoke-tight partition. Additionally, common spaces shall be separated from the exit access corridor by a smoke-tight partition.
- 2B.8.7.3 Openings in room face.** The aggregate area of openings in a solid sleeping room face in Occupancy Conditions 2, 3, 4 and 5 shall not exceed 77,419 mm<sup>2</sup>. The aggregate area shall include all openings including door undercuts, food passes and grilles. Openings shall be not more than 914 mm above the floor. In Occupancy Condition 5, the openings shall be closeable from the room side.
- 2B.8.7.4 Smoke-tight doors.** Doors in openings in partitions required to be smoke tight by Section 2B.8.7 shall be substantial doors, of construction that will resist the passage of smoke. Latches and door closures are not required on cell doors.
- 2B.8.8 Windowless buildings.** For the purposes of this section, a windowless building or portion of a building is one with non-openable windows, windows not readily breakable or without windows. Windowless buildings shall be provided with an engineered smoke control system to provide ventilation (mechanical or natural) in accordance with Section 7.9 for each windowless smoke compartment.

## SECTION 2B.9

### MOTION PICTURE PROJECTION ROOMS

- 2B.9.1 General.** The provisions of this section shall apply to rooms in which ribbon-type cellulose acetate or other safety film is utilized in conjunction with electric arc, xenon or other light-source projection equipment that develops hazardous gases, dust or radiation. Where cellulose nitrate film is utilized or stored, such rooms shall comply with NFPA 40.
- 2B.9.1.1 Projection room required.** Every motion picture machine projecting film as mentioned within the scope of this section shall be enclosed in a projection room. Appurtenant electrical equipment, such as rheostats, transformers and generators, shall be within the projection room or in an adjacent room of equivalent construction.
- 2B.9.2 Construction of projection rooms.** Every projection room shall be of permanent construction consistent with the construction requirements for the type of building in which the projection room is located. Openings are not required to be protected. The room shall have a floor area of not less than 7.44 m<sup>2</sup> for a single machine and at least 3.7 m<sup>2</sup> for each additional machine. Each motion picture projector, floodlight, spotlight or similar piece of equipment shall have a clear working space of not less than 762 mm by 762 mm on each side and at the rear thereof, but only one such space shall be required between two adjacent projectors. The projection room and the rooms appurtenant thereto shall have a ceiling height of not less than 2.3 m. The aggregate of openings for projection equipment shall not exceed 25 percent of the area of the wall between the projection room and the auditorium. Openings shall be provided with glass or other approved material, so as to close completely the opening.
- 2B.9.3 Projection room and equipment ventilation.** Ventilation shall be provided in accordance with the SBC 501.
- 2B.9.3.1 Projection room.**
- 2B.9.3.1.1 Supply air.** Each projection room shall be provided with adequate air supply inlets so arranged as to provide well-distributed air throughout the room. Air inlet ducts shall provide an amount of air equivalent to the amount of air being exhausted by projection equipment. Air is permitted to be taken from the outside; from adjacent spaces within the building, provided the volume and infiltration rate is sufficient; or from the building air-conditioning system, provided it is so arranged as to provide sufficient air when other systems are not in operation.
- 2B.9.3.1.2 Exhaust air.** Projection rooms are permitted to be exhausted through the lamp exhaust system. The lamp exhaust system shall be positively interconnected with the lamp so that the lamp will not operate unless there is the required airflow. Exhaust air ducts shall terminate at the exterior of the building in such a location that the exhaust air cannot be readily re-circulated into any air supply system. The projection room ventilation system is permitted to also serve appurtenant rooms, such as the generator and rewind rooms.
- Each projection machine shall be provided with an exhaust duct that will draw air from each lamp and exhaust it directly to the outside of the building. The lamp exhaust is permitted to serve to exhaust air from the projection room to provide room air circulation. Such ducts shall be of rigid materials except for a flexible connector approved for the purpose. The projection lamp or projection room exhaust system, or both, is permitted to be combined but shall not be interconnected with any other exhaust or return system, or both, within the

building.

- 2B.9.4 Lighting control.** Provisions shall be made for control of the auditorium lighting and the means of egress lighting systems of theaters from inside the projection room and from at least one other convenient point in the building.
- 2B.9.5 Miscellaneous equipment.** Each projection room shall be provided with rewind and film storage facilities.

## SECTION 2B.10 STAGES AND PLATFORMS

- 2B.10.1 Applicability.** The provisions of this section shall apply to all parts of buildings and structures that contain stages or platforms and similar appurtenances as herein defined.
- 2B.10.2 Definitions.** The following words and terms shall, for the purposes of this section and as used elsewhere in these code requirements, have the meanings shown herein.

**FLY GALLERY.** A raised floor area above a stage from which the movement of scenery and operation of other stage effects are controlled.

**GRIDIRON.** The structural framing over a stage supporting equipment for hanging or flying scenery and other stage effects.

**PINRAIL.** A rail on or above a stage through which belaying pins are inserted and to which lines are fastened.

**PLATFORM.** A raised area within a building used for religious teaching/lecturing, the presentation of music, plays or other entertainment; the head table for special guests; the raised area for lecturers and speakers; boxing and wrestling rings; theater-in-the-round stages; and similar purposes wherein there are no overhead hanging curtains, drops, scenery or stage effects other than lighting and sound. A temporary platform is one installed for not more than 30 days.

**PROSCENIUM WALL.** The wall that separates the stage from the auditorium or assembly seating area.

**STAGE.** A space within a building utilized for entertainment or presentations, which includes overhead hanging curtains, drops, scenery or stage effects other than lighting and sound. Stage area shall be measured to include the entire performance area and adjacent backstage and support areas not separated from the performance area by fire-resistance-rated construction. Stage height shall be measured from the lowest point on the stage floor to the highest point of the roof or floor deck above the stage.

- 2B.10.3 Stages.** Stage construction shall comply with Sections 2B.10.3.1 through 2B.10.3.7.
- 2B.10.3.1 Stage construction.** Stages shall be constructed of materials as required for floors for the type of construction of the building in which such stages are located.



**Exceptions:**

1. Stages of Type IIB or IV construction with a nominal 51 mm wood deck, provided that the stage is separated from other areas in accordance with Section 2B.10.3.5.
2. In buildings of Type IIA, IIIA and VA construction, a fire-resistance-rated floor is not required, provided the space below the stage is equipped with an automatic fire-extinguishing system in accordance with Section 7.3 or 7.4.
3. In all types of construction, the finished floor shall be constructed of wood or approved noncombustible materials. Openings through stage floors shall be equipped with tight-fitting, solid wood trap doors with approved safety locks.

**2B.10.3.1.1 Stage height and area.** Stage areas shall be measured to include the entire performance area and adjacent backstage and support areas not separated from the performance area by fire-resistance-rated construction. Stage height shall be measured from the lowest point on the stage floor to the highest point of the roof or floor deck above the stage.

**2B.10.3.2 Galleries, gridirons, catwalks and pinrails.** Beams designed only for the attachment of portable or fixed theater equipment, gridirons, galleries and catwalks shall be constructed of approved materials consistent with the requirements for the type of construction of the building; and a fire-resistance rating shall not be required. These areas shall not be considered to be floors, stories, mezzanines or levels in applying these code requirements.

**Exception:** Floors of fly galleries and catwalks shall be constructed of any approved material.

**2B.10.3.3 Exterior stage doors.** Where protection of openings is required, exterior exit doors shall be protected with fire doors that comply with Section 4B.15. Exterior openings that are located on the stage for means of egress or loading and unloading purposes, and that are likely to be open during occupancy of the theater, shall be constructed with vestibules to prevent air drafts into the auditorium.

**2B.10.3.4 Proscenium wall.** Where the stage height is greater than 15.3 m, all portions of the stage shall be completely separated from the seating area by a proscenium wall with not less than a 2 hours fire-resistance rating extending continuously from the foundation to the roof.

**2B.10.3.5 Proscenium curtain.** The proscenium opening of every stage with a height greater than 15.3 m shall be provided with a curtain of approved material or an approved water curtain complying with Section 7.3.3.1.1. The curtain shall be designed and installed to intercept hot gases, flames and smoke, and to prevent a glow from a severe fire on the stage from showing on the auditorium side for a period of 20 minutes. The closing of the curtain from the full open position shall be effected in less than 30 seconds, but the last 2.4 m of travel shall require not less than 5 seconds.

**2B.10.3.5.1 Activation.** The curtain shall be activated by rate-of-rise heat detection installed in accordance with Section 7.7.10 operating at a rate of temperature rise of 8 to 11°C per minute, and by an auxiliary manual control.

**2B.10.3.5.2 Fire test.** A sample curtain with a minimum of two vertical seams shall be subjected to the standard fire test specified in ASTM E 119 for a period of 30 minutes. The curtain shall overlap the furnace edges by an amount that is appropriate to seal the top and sides. The curtain shall have a bottom pocket containing a minimum of 58 N/m of batten. The exposed surface of the curtain shall not glow, and flame or smoke shall not penetrate the curtain during the test period. Unexposed surface temperature and hose stream test requirements are not applicable to the proscenium fire safety curtain test.

**2B.10.3.5.3 Smoke test.** Curtain fabrics shall have a smoke-developed rating of 25 or less

when tested in accordance with ASTM E 84.

- 2B.10.3.5.4 Tests.** The completed proscenium curtain shall be subjected to operating tests prior to the issuance of a certificate of occupancy.
- 2B.10.3.6 Scenery.** Combustible materials used in sets and scenery shall be rendered flame resistant in accordance with Section 6.5. Foam plastics and materials containing foam plastics shall comply with Section 11.3 of SBC 201 and these code requirements.
- 2B.10.3.7 Stage ventilation.** Emergency ventilation shall be provided for stages larger than 93 m<sup>2</sup> in floor area, or with a stage height greater than 15.3 m. Such ventilation shall comply with Section 2B.10.3.7.1 or 2B.10.3.7.2.
- 2B.10.3.7.1 Roof vents.** Two or more vents constructed to open automatically by approved heat-activated devices and with an aggregate clear opening area of not less than 5 percent of the area of the stage shall be located near the center and above the highest part of the stage area. Supplemental means shall be provided for manual operation of the ventilator. Curbs shall be provided as required for skylights in Section 11.10.2 of SBC 201. Vents shall be labeled.
- 2B.10.3.7.2 Smoke control.** Smoke control in accordance with Section 7.9 shall be provided to maintain the smoke layer interface not less than 1.8 m above the highest level of the assembly seating or above the top of the proscenium opening where a proscenium wall is provided in compliance with Section 2B.10.3.4.
- 2B.10.4 Platform construction.** Permanent platforms shall be constructed of materials as required for the type of construction of the building in which the permanent platform is located. Permanent platforms are permitted to be constructed of fire-retardant-treated wood for Type I, II, and IV construction where the platforms are not more than 762 mm above the main floor, and not more than one-third of the room floor area and not more than 279 m<sup>2</sup> in area. Where the space beneath the permanent platform is used for storage or any other purpose other than equipment, wiring or plumbing, the floor construction shall not be less than 1-hour fire-resistant construction. Where the space beneath the permanent platform is used only for equipment, wiring or plumbing, the underside of the permanent platform need not be protected.
- 2B.10.4.1 Temporary platforms.** Platforms installed for a period of not more than 30 days are permitted to be constructed of any materials permitted by the code. The space between the floor and the platform above shall only be used for plumbing and electrical wiring to platform equipment.
- 2B.10.5 Dressing and appurtenant rooms.** Dressing and appurtenant rooms shall comply with Sections 2B.10.5.1 through 2B.10.5.4.
- 2B.10.5.1 Separation from stage.** Where the stage height is greater than 15.3 m, the stage shall be separated from dressing rooms, scene docks, property rooms, workshops, storerooms and compartments appurtenant to the stage and other parts of the building by a fire barrier wall and horizontal assemblies or both with not less than a 2 hours fire-resistance rating with approved opening protectives. For stage heights of 15.3 m or less, the required stage separation shall be a fire barrier wall and horizontal assemblies, or both, with not less a 1 hour fire-resistance rating with approved opening protectives.
- 2B.10.5.2 Separation from each other.** Separate dressing rooms for each gender, scene docks, property rooms, workshops, storerooms and compartments appurtenant to the stage shall be separated from each other by fire barrier wall and horizontal assemblies, or both, with not less than a 1 hour fire-resistance rating with approved opening protectives.

- 2B.10.5.3 Opening protectives.** Openings other than to trunk rooms and the necessary doorways at stage level shall not connect such rooms with the stage, and such openings shall be protected with fire door assemblies that comply with Section 4B.15.
- 2B.10.5.4 Stage exits.** At least one approved means of egress shall be provided from each side of the stage; and from each side of the space under the stage. At least one means of escape shall be provided from each fly gallery and from the gridiron. A steel ladder, alternating tread stairway or spiral stairway is permitted to be provided from the gridiron to a scuttle in the stage roof.
- 2B.10.6 Automatic sprinkler system.** Stages shall be equipped with an automatic fire-extinguishing system in accordance with Chapter 7. The system shall be installed under the roof and gridiron, in the tie and fly galleries and in places behind the proscenium wall of the stage and in dressing rooms, lounges, workshops and storerooms accessory to such stages.
- Exceptions:**
1. Sprinklers are not required under stage areas less than 1.2 m in clear height utilized exclusively for storage of tables and chairs, provided the concealed space is separated from the adjacent spaces by not less than 15.9 mm Type X gypsum board.
  2. Sprinklers are not required for stages 93 m<sup>2</sup> or less in area and 15.3 m or less in height where curtains, scenery or other combustible hangings are not retractable vertically. Combustible hangings shall be limited to a single main curtain, borders, legs and a single backdrop.
- 2B.10.7 Standpipes.** Standpipe systems shall be provided in accordance with Section 7.5.

## SECTION 2B.11 SPECIAL AMUSEMENT BUILDINGS

- 2B.11.1 General.** Special amusement buildings having an occupant load of 50 or more shall comply with the requirements for the appropriate Group A occupancy and this section. Amusement buildings having an occupant load of less than 50 shall comply with the requirements for a Group B occupancy and this section.
- Exception:** Amusement buildings or portions thereof that are without walls or a roof and constructed to prevent the accumulation of smoke.  
For flammable decorative materials, see these code requirements.
- 2B.11.2 Special amusement building.** A special amusement building is any temporary or permanent building or portion thereof that is occupied for amusement, entertainment or educational purposes and that contains a device or system that conveys passengers or provides a walkway along, around or over a course in any direction so arranged that the means of egress path is not readily apparent due to visual or audio distractions or is intentionally confounded or is not readily available because of the nature of the attraction or mode of conveyance through the building or structure.
- 2B.11.3 Automatic fire detection.** Special amusement buildings shall be equipped with an automatic fire detection system in accordance with Section 7.7.
- 2B.11.4 Automatic sprinkler system.** Special amusement buildings shall be equipped throughout with an automatic sprinkler system in accordance with Section



7.3.3.1.1. Where the special amusement building is temporary, the sprinkler water supply shall be of an approved temporary means.

**Exception:** Automatic fire sprinklers are not required where the total floor area of a temporary special amusement building is less than 93 m<sup>2</sup> and the travel distance from any point to an exit is less than 15.3 m.

- 2B.11.5 Alarm.** Actuation of a single smoke detector, the automatic sprinkler system or other automatic fire detection device shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated including the capability of manual initiation of requirements in Section 7.7.2.11.2.
- 2B.11.6 Emergency voice/alarm communications system.** An emergency voice/alarm communications system shall be provided in accordance with Sections 7.7.2.11 and 7.7.2.12.2, which is also permitted to serve as a public address system and shall be audible throughout the entire special amusement building.
- 2B.11.7 Exit marking.** Exit signs shall be installed at the required exit or exit access doorways of amusement buildings. Approved directional exit markings shall also be provided. Where mirrors, mazes or other designs are utilized that disguise the path of egress travel such that they are not apparent, approved low level exit signs and directional path markings shall be provided and located not more than 203 mm above the walking surface and on or near the path of egress travel. Such markings shall become visible in an emergency. The directional exit marking shall be activated by the automatic fire detection system and the automatic sprinkler system in accordance with Section 7.7.2.11.2.
- 2B.11.8 Interior finish.** The interior finish shall be Class A in accordance with Section 6.3.1.

## SECTION 2B.12 AIRCRAFT-RELATED OCCUPANCIES

- 2B.12.1 Airport traffic control towers.**
- 2B.12.1.1 General.** The provisions of this section shall apply to airport traffic control towers not exceeding 140 m<sup>2</sup> per floor occupied only for the following uses:
1. Airport traffic control cab,
  2. Electrical and mechanical equipment rooms,
  3. Airport terminal radar and electronics rooms,
  4. Office spaces incidental to the tower operation,
  5. Lounges for employees, including sanitary facilities.
- 2B.12.1.2 Type of construction.** Airport traffic control towers shall be constructed to conform to the height and area limitations of Table 2B.12.1.2.
- 2B.12.1.3 Egress.** A minimum of one exit stairway shall be permitted for airport traffic control towers of any height provided that the occupant load per floor does not exceed 15. The stairway shall conform to the requirements of Section 8.9. The stairway shall be separated from elevators by a minimum distance of one-half of the diagonal of the area served measured in a straight line. The exit stairway and elevator hoistway are permitted to be located in the same shaft enclosure, provided they are separated from each other by a 4-hour separation having no openings. Such stairway shall be pressurized to a minimum of 43 Pa and a maximum of 101 Pa in the shaft relative to the building with stairway doors closed. Stairways need

not extend to the roof as specified in Section 8.9.12. The provisions of Section 2B.3 do not apply.

**Exception:** Smokeproof enclosures as set forth in Section 8.9.1.8 are not required where required stairways are pressurized.

**TABLE 2B.12.1.2  
HEIGHT AND AREA LIMITATIONS FOR AIRPORT TRAFFIC  
CONTROL TOWERS**

TYPE OF CONSTRUCTION	HEIGHT <sup>a</sup> (meters)	MAXIMUM AREA (square meters)
IA	Unlimited	139.4
IB	73	139.4
IIA	30.5	139.4
IIB	26	139.4
IIIA	19.8	139.4

a. Height to be measured from grade to cab floor.

**2B.12.1.4 Automatic fire detection systems.** Airport traffic control towers shall be provided with an automatic fire detection system installed in accordance with Section 7.7.2.

**2B.12.1.5 Standby power.** A standby power system that conforms to SBC 401 shall be provided in airport traffic control towers more than 19.8 m in height. Power shall be provided to the following equipment:

1. Pressurization equipment, mechanical equipment and lighting.
2. Elevator operating equipment.
3. Fire alarm and smoke detection systems.

**2B.12.1.6 Accessibility.** Airport traffic control towers need not be accessible as specified in the provisions of Chapter 9 of SBC 201.

**2B.12.2 Aircraft hangar.**

**2B.12.2.1 Exterior walls.** Exterior walls located less than 9.1 m from property lines, lot lines or a public way shall have a fire-resistance rating not less than 2 hours.

**2B.12.2.2 Basements.** Where hangars have basements, the floor over the basement shall be of Type IA construction and shall be made tight against seepage of water, oil or vapors. There shall be no opening or communication between the basement and the hangar. Access to the basement shall be from outside only.

**2B.12.2.3 Floor surface.** Floors shall be graded and drained to prevent water or fuel from remaining on the floor. Floor drains shall discharge through an oil separator to the sewer or to an outside vented sump.

**2B.12.2.4 Heating equipment.** Heating equipment shall be placed in another room separated by 2 hours fire-resistance-rated construction. Entrance shall be from the outside or by means of a vestibule providing a two-doorway separation.

**Exceptions:**

1. Unit heaters suspended at least 3.1 m above the upper surface of wings or engine enclosures of the highest aircraft that are permitted to be housed in the hangar and at least 2.4 m above the floor in shops, offices and other sections of the hangar communicating with storage or service areas.
2. A single interior door shall be allowed, provided the sources of ignition in the appliances are at least 457 mm above the floor.

**2B.12.2.5 Finishing.** The process of “doping,” involving use of a volatile flammable solvent, or of painting, shall be carried on in a separate detached building equipped with automatic fire-extinguishing equipment in accordance with Section 7.3.

**2B.12.2.6 Fire suppression.** Aircraft hangars shall be provided with fire suppression as required in NFPA 409.

**Exception:** Group II hangars as defined in NFPA 409 storing private aircraft without major maintenance or overhaul are exempt from foam suppression requirements.

**2B.12.3 Residential aircraft hangars.** Residential aircraft hangars as defined in Section 2B.12.3.1 shall comply with Sections 2B.12.3.2 through 2B.12.3.6.

**2B.12.3.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**RESIDENTIAL AIRCRAFT HANGAR.** An accessory building less than 186 m<sup>2</sup> and 6.1 m in height, constructed on a one- or two-family residential property where aircraft are stored. Such use will be considered as a residential accessory use incidental to the dwelling.

**2B.12.3.2 Fire separation.** A hangar shall not be attached to a dwelling unless separated by walls having a fire-resistance rating of not less than 1 hour. Such separation shall be continuous from the foundation to the underside of the roof and un-pierced except for doors leading to the dwelling unit. Doors into the dwelling unit must be equipped with self-closing devices and conform to the requirements of Section 4B.15 with at least a 102 mm noncombustible raised sill. Openings from a hangar directly into a room used for sleeping purposes shall not be permitted.

**2B.12.3.3 Egress.** A hangar shall provide two means of egress. One of the doors into the dwelling shall be considered as meeting only one of the two means of egress.

**2B.12.3.4 Smoke detection.** Smoke alarms shall be provided within the hangar in accordance with Section 7.7.2.21.

**2B.12.3.5 Independent systems.** Mechanical and plumbing drain, waste and vent (DWV) systems installed within the hangar shall be independent of the systems installed within the dwelling. Building sewer lines may connect outside the structures.

**Exception:** Smoke detector wiring and feed for electrical sub-panels in the hangar.

**2B.12.3.6 Height and area limits.** Residential aircraft hangars shall not exceed 186 m<sup>2</sup> in area and 6.1 m in height.

**2B.12.4 Aircraft paint hangars.** Aircraft painting operations where flammable liquids are used in excess of the maximum allowable quantities per control area listed in Table 2A.7.7(1) shall be conducted in an aircraft paint hangar that complies with the provisions of Section 2B.12.4.

**2B.12.4.1 Occupancy group.** Aircraft paint hangars shall be classified as Group H-2. Aircraft paint hangars shall comply with the applicable requirements of these code requirements and the SBC 201 for such occupancy.

**2B.12.4.2 Construction.** The aircraft paint hangar shall be of Type I or II construction.

**2B.12.4.3 Operations.** Only those flammable liquids necessary for painting operations shall be permitted in quantities less than the maximum allowable quantities per control area in Table 2A.7.7(1). Spray equipment cleaning operations shall be conducted in a liquid use, dispensing and mixing room.

**2B.12.4.4 Storage.** Storage of flammable liquids shall be in a liquid storage room.

**2B.12.4.5 Fire suppression.** Aircraft paint hangars shall be provided with fire suppression as required in NFPA 409.

**2B.12.4.6 Ventilation.** Aircraft paint hangars shall be provided with ventilation as required in the SBC 501.

**2B.12.5 Heliports and helistops.**

**2B.12.5.1 General.** Heliports and helistops may be erected on buildings or other locations where they are constructed in accordance with this section.

**2B.12.5.2 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**HELIPORT.** An area of land or water or a structural surface that is used, or intended for use, for the landing and taking off of helicopters, and any appurtenant areas that are used, or intended for use, for heliport buildings and other heliport facilities.

**HELISTOP.** The same as a “Heliport,” except that no fueling, de-fueling, maintenance, repairs or storage of helicopters is permitted.

**2B.12.5.3 Size.** The touchdown or landing area for helicopters of less than 1,588 kg shall be a minimum of 6.1 m in length and width. The touchdown area shall be surrounded on all sides by a clear area having a minimum average width at roof level of 4.6 m but with no width less than 1.5 m.

**2B.12.5.4 Design.** Helicopter landing areas and the supports thereof on the roof of a building shall be noncombustible construction. Landing areas shall be designed to confine any flammable liquid spillage to the landing area itself and provisions shall be made to drain such spillage away from any exit or stairway serving the helicopter landing area or from a structure housing such exit or stairway. For structural design requirements, see SBC 301.

**2B.12.5.5 Means of egress.** The means of egress from heliports and helistops shall comply with the provisions of Chapter 8. Landing areas located on buildings or structures shall have two or more means of egress. For landing platforms or roof areas less than 18.3 m in length, or less than 187 m<sup>2</sup> in area, the second means of egress may be a fire escape or ladder leading to the floor below.

**2B.12.5.6 Rooftop heliports and helistops.** Rooftop heliports and helistops shall comply with NFPA 418.

## **SECTION 2B.13 COMBUSTIBLE STORAGE**

**2B.13.1 General.** High-piled stock or rack storage in any occupancy group shall comply with these code requirements.

**2B.13.2 Attic, under-floor and concealed spaces.** Attic, under-floor and concealed spaces used for storage of combustible materials shall be protected on the storage side as required for 1 hour fire-resistant construction. Openings shall be protected by assemblies that are self-closing and are of noncombustible construction or solid wood core not less than 45 mm in thickness.

**Exceptions:**

1. Areas protected by approved automatic sprinkler systems.
2. Group R-3 and U occupancies.

## **SECTION 2B.14 HAZARDOUS MATERIALS**

**2B.14.1 General.** The provisions of this section shall apply to buildings and structures

occupied for the manufacturing, processing, dispensing, use or storage of hazardous materials.

- 2B.14.1.1 Other provisions.** Buildings and structures with an occupancy in Group H shall also comply with the applicable provisions of Section 2B.15 and these code requirements.
- 2B.14.1.2 Materials.** The safe design of hazardous material occupancies is material dependent. Individual material requirements are also found in Sections 2A.7 and 2B.15, and in the SBC 501 and these code requirements.
- 2B.14.1.2.1 Materials.** The safe design of hazardous material occupancies is material dependent. Individual material requirements are also found in Sections 2A.7 and 2B.15, and in the SBC 501 and these code requirements.
- 2B.14.1.2.2 Aerosols.** Level 2 and 3 aerosol products shall be stored and displayed in accordance with the code requirements. See Section 2A.11.2 and these code requirements for occupancy group requirements.
- 2B.14.1.3 Information required.** Separate floor plans shall be submitted for buildings and structures with an occupancy in Group H, identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure. A report identifying hazardous materials including, but not limited to, materials representing hazards that are classified in Group H to be stored or used, shall be submitted and the methods of protection from such hazards shall be indicated on the construction documents. The opinion and report shall be prepared by a qualified person, firm or corporation approved by the concerning building official and shall be provided without charge to the enforcing agency.
- 2B.14.2 Control areas.** Control areas shall be those spaces within a building where quantities of hazardous materials not exceeding the maximum quantities allowed by these code requirements are stored, dispensed, used or handled.
- 2B.14.2.1 Construction requirements.** Control areas shall be separated from each other by not less than a 1 hour fire barrier constructed in accordance with Chapter 4.
- 2B.14.2.2 Number.** The maximum number of control areas within a building shall be in accordance with Table 2B.14.2.2.

**TABLE 2B.14.2.2  
DESIGN AND NUMBER OF CONTROL AREAS**

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA <sup>a</sup>	NUMBER OF CONTROL AREAS PER FLOOR <sup>b</sup>	FIRE- RESISTANCE RATING FOR FIRE BARRIERS IN HOURS <sup>c</sup>
Above grade	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 2A.7.7(1) and 2A.7.7(2), with all increases allowed in the notes to those tables.

b. There shall be a maximum of two control areas per floor in Group M occupancies and in buildings or portions of buildings having Group S occupancies with storage conditions and quantities in accordance with Section 2B.14.2.4.

c. Fire barriers shall include walls and floors as necessary to provide separation from other portions of the building.

- 2B.14.2.3 Separation.** The required fire-resistance rating for fire barrier assemblies shall be in accordance with Table 2B.14.2.2. The floor construction of the control area, and the construction supporting the floor of the control area, shall have a minimum 2 hours fire-resistance rating.
- 2B.14.2.4 Hazardous material in Group M display and storage areas and in Group S storage areas.** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials permitted within a single control area of a Group M or S occupancy or an outdoor control area is permitted to exceed the maximum allowable quantities per control area specified in Tables 2A.7.7(1) and 2A.7.7(2) without classifying the building or use as a Group H occupancy, provided that the materials are displayed and stored in accordance with these code requirements and quantities do not exceed the maximum allowable specified in Table 2B.14.2.4.
- 2B.14.3 Ventilation.** Rooms, areas or spaces of Group H in which explosive, corrosive, combustible, flammable or highly toxic dusts, mists, fumes, vapors or gases are or may be emitted due to the processing, use, handling or storage of materials shall be mechanically ventilated as required by these code requirements and the SBC 501. Ducts conveying explosives or flammable vapors, fumes or dusts shall extend directly to the exterior of the building without entering other spaces. Exhaust ducts shall not extend into or through ducts and plenums.

**TABLE 2B.14.2.4**  
**MAXIMUM ALLOWABLE QUANTITY PER INDOOR AND OUTDOOR CONTROL AREA IN GROUP M AND S**  
**OCCUPANCIES NONFLAMMABLE SOLIDS AND NONFLAMMABLE AND NONCOMBUSTIBLE LIQUIDS<sup>d,e,f</sup>**

CONDITION		MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA	
Material <sup>a</sup>	Class	Solids kilograms	Liquids liters
<b>A. Health-hazard materials—nonflammable and noncombustible solids and liquids</b>			
1. Corrosives <sup>b, c</sup>	Not Applicable	4,427	3,690
2. Highly toxics	Not Applicable	9.1 <sup>b, c</sup>	7.6 <sup>b, c</sup>
3. Toxics <sup>b, c</sup>	Not Applicable	454	379
<b>B. Physical-hazard materials—nonflammable and noncombustible solids and liquids</b>			
1. Oxidizers <sup>b, c</sup>	4	Not Allowed	Not Allowed
	3	522 <sup>g</sup>	435
	2	1,022 <sup>h</sup>	852
	1	8,172 <sup>i, j</sup>	6,813 <sup>i, j</sup>
2. Unstable (reactives) <sup>b, c</sup>	4	Not Allowed	Not Allowed
	3	250	208
	2	522	435
	1	Not Limited	Not Limited
3. Water (reactives)	3 <sup>b, c</sup>	250	208
	2 <sup>b, c</sup>	522	435
	1	Not Limited	Not Limited

- a. Hazard categories are as specified in these code requirements.
- b. Maximum allowable quantities shall be increased 100 percent in buildings that are sprinklered in accordance with Section 7.3.3.1.1. When Note c also applies, the increase for both notes shall be applied accumulatively.
- c. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, in accordance with these code requirements. When Note b also applies, the increase for both notes shall be applied accumulatively.
- d. See Table 2B.14.2.2 for design and number of control areas.
- e. Allowable quantities for other hazardous material categories shall be in accordance with Section 2A.7.
- f. Maximum quantities shall be increased 100 percent in outdoor control areas.
- g. Maximum amounts are permitted to be increased to 1,022 kilograms when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 4.5 kilograms each.
- h. Maximum amounts are permitted to be increased to 2,043 kilograms when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 4.5 kilograms each.
- i. Quantities are unlimited where protected by an automatic sprinkler system.
- j. Quantities are unlimited in an outdoor control area.



**Exception:** Ducts conveying vapor or fumes having flammable constituents less than 25 percent of their lower flammable limit (LFL) are permitted to pass through other spaces.

Emissions generated at workstations shall be confined to the area in which they are generated as specified in these code requirements and the SBC 501.

The location of supply and exhaust openings shall be in accordance with the SBC 501. Exhaust air contaminated by highly toxic material shall be treated in accordance with these code requirements.

A manual shutoff control for ventilation equipment required by this section shall be provided outside the room adjacent to the principal access door to the room. The switch shall be of the break-glass type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.

- 2B.14.4 Hazardous material systems.** Systems involving hazardous materials shall be suitable for the intended application. Controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls, where provided, shall be designed to be failing safe.
- 2B.14.5 Inside storage, dispensing and use.** The inside storage, dispensing and use of hazardous materials in excess of the maximum allowable quantities per control area of Tables 2A.7.7(1) and 2A.7.7(2) shall be in accordance with Sections 2B.14.5.1 through 2B.14.5.5 of these code requirements and the SBC 201.
- 2B.14.5.1 Explosion control.** Explosion control shall be provided in accordance with these code requirements as required by Table 2B.14.5.1 where quantities of hazardous materials specified in that table exceed the maximum allowable quantities in Table 2A.7.7(1) or where a structure, room or space is occupied for purposes involving explosion hazards as required by Section 2B.15 or these code requirements.
- 2B.14.5.2 Monitor control equipment.** Monitor control equipment shall be provided where required by these code requirements.
- 2B.14.5.3 Automatic fire detection systems.** Group H occupancies shall be provided with an automatic fire detection system in accordance with Section 7.7.2.
- 2B.14.5.4 Standby or emergency power.** Where mechanical ventilation, treatment systems, temperature control, alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with the SBC 401.
- Exceptions:**
1. Storage areas for Class I and II oxidizers.
  2. Storage areas for Class III, IV and V organic peroxides.
  3. Storage, use and handling areas for highly toxic or toxic materials as provided for in these code requirements.
  4. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an approved fail-safe engineered system is installed.
- 2B.14.5.5 Spill control, drainage and containment.** Rooms, buildings or areas occupied for the storage of solid and liquid hazardous materials shall be provided with a means to control spillage and to contain or drain off spillage and fire protection water discharged in the storage area where required in these code requirements. The methods of spill control shall be in accordance with these code requirements.

**TABLE 2B.14.5.1**  
**EXPLOSION CONTROL REQUIREMENTS<sup>a</sup>**

MATERIAL	CLASS	EXPLOSION CONTROL METHODS	
		Barricade construction	Explosion (deflagration) venting or explosion (deflagration) prevention systems <sup>b</sup>
HAZARD CATEGORY			
Combustible dusts <sup>c</sup>	—	Not Required	Required
Cryogenic flammables	—	Not Required	Required
Explosives	Division 1.1	Required	Not Required
	Division 1.2	Required	Not Required
	Division 1.3	Not Required	Required
	Division 1.4	Not Required	Required
	Division 1.5	Required	Not Required
	Division 1.6	Required	Not Required
Flammable gas	Gaseous	Not Required	Required
	Liquefied	Not Required	Required
Flammable liquid	IA <sup>d</sup>	Not Required	Required
	IB <sup>e</sup>	Not Required	Required
Organic peroxides	U	Required	Not Permitted
	I	Required	Not Permitted
Oxidizer liquids and solids	4	Required	Not Permitted
Pyrophoric gas	—	Not Required	Required
Unstable (reactive)	4	Required	Not Permitted
	3 Detonable	Required	Not Permitted
	3 Nondetonable	Not Required	Required
Water-reactive liquids and solids	3	Not Required	Required
	2 <sup>g</sup>	Not Required	Required
SPECIAL USES			
Acetylene generator rooms	—	Not Required	Required
Grain processing	—	Not Required	Required
Liquefied petroleum gas-distribution facilities	—	Not Required	Required
Where explosion hazards exist <sup>f</sup>	Detonation	Required	Not Permitted
	Deflagration	Not Required	Required

a. See Section 2B.14.1.3.

b. See other chapters of these code requirements.

c. As generated during manufacturing or processing. See definition of “Combustible dust” in Chapter 2.

d. Storage or use.

e. In open use or dispensing.

f. Rooms containing dispensing and use of hazardous materials when an explosive environment can occur because of the characteristics or nature of the hazardous materials or as a result of the dispensing or use process.

g. A method of explosion control shall be provided when Class 2 water-reactive materials can form potentially explosive mixtures.

**2B.14.6 Outdoor storage, dispensing and use.** The outdoor storage, dispensing and use of hazardous materials shall be in accordance with these code requirements.

**2B.14.6.1 Weather protection.** Where weather protection is provided for sheltering outdoor hazardous material storage or use areas, such storage or use shall be considered outdoor storage or use, provided that all of the following conditions are met:

1. Structure supports and walls shall not obstruct more than one side or more than 25 percent of the perimeter of the storage or use area.
2. The distance from the structure and the structure supports to buildings, lot lines, public ways or means of egress to a public way shall not be less than the distance required for an outside hazardous material storage or use area without weather protection.
3. The overhead structure shall be of approved noncombustible construction with a maximum area of 140 m<sup>2</sup>.

**Exception:** The increases permitted by Section 3.6 apply.



- 2B.14.7 Emergency alarms.** Emergency alarms for the detection and notification of an emergency condition in Group H occupancies shall be provided as set forth herein.
- 2B.14.7.1 Storage.** An approved manual emergency alarm system shall be provided in buildings, rooms or areas used for storage of hazardous materials. Emergency alarm-initiating devices shall be installed outside of each interior exit or exit access door of storage buildings, rooms or areas. Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants of an emergency situation involving hazardous materials.
- 2B.14.7.2 Dispensing, use and handling.** Where hazardous materials having a hazard ranking of 3 or 4 in accordance with NFPA 704 are transported through corridors or exit enclosures, there shall be an emergency telephone system, a local manual alarm station or an approved alarm-initiating device at not more than 45.7 m intervals and at each exit and exit access doorway throughout the transport route. The signal shall be relayed to an approved central, proprietary or remote station service or constantly attended on-site location and shall also initiate a local audible alarm.
- 2B.14.7.3 Supervision.** Emergency alarm systems shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

## SECTION 2B.15

### GROUPS H-1, H-2, H-3, H-4 AND H-5

- 2B.15.1 Scope.** The provisions of this section shall apply to the storage and use of hazardous materials in excess of the maximum allowable quantities per control area listed in Section 2A.7.9. Buildings and structures with an occupancy in Group H shall also comply with the applicable provisions of Section 2B.14 and these code requirements.
- 2B.15.2 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in the code, have the meanings shown herein.

**CONTINUOUS GAS-DETECTION SYSTEM.** A gas detection system where the analytical instrument is maintained in continuous operation and sampling is performed without interruption. Analysis is allowed to be performed on a cyclical basis at intervals not to exceed 30 minutes.

**EMERGENCY CONTROL STATION.** An approved location on the premises where signals from emergency equipment are received and which is staffed by trained personnel.

**EXHAUSTED ENCLOSURE.** An appliance or piece of equipment that consists of a top, a back and two sides providing a means of local exhaust for capturing gases, fumes, vapors and mists. Such enclosures include laboratory hoods, exhaust fume hoods and similar appliances and equipment used to locally retain and exhaust the gases, fumes, vapors and mists that could be released. Rooms or areas provided with general ventilation, in themselves, are not exhausted enclosures.

**FABRICATION AREA.** An area within a semiconductor fabrication facility and related research and development areas in which there are processes using hazardous production materials. Such areas are allowed to include ancillary rooms or areas such as dressing rooms and offices that are directly related to the

fabrication area processes.

**FLAMMABLE VAPORS OR FUMES.** The concentration of flammable constituents in air that exceed 10 percent of their lower flammable limit (LFL).

**GAS CABINET.** A fully enclosed, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage or use. Doors and access ports for exchanging cylinders and accessing pressure-regulating controls are allowed to be included.

**GAS ROOM.** A separately ventilated, fully enclosed room in which only compressed gases and associated equipment and supplies are stored or used.

**HAZARDOUS PRODUCTION MATERIAL (HPM).** A solid, liquid or gas associated with semiconductor manufacturing that has a degree-of-hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by NFPA 704 and which is used directly in research, laboratory or production processes that have as their end product materials that are not hazardous.

**HPM FLAMMABLE LIQUID.** An HPM liquid that is defined as either a Class I flammable liquid or a Class II or Class IIIA combustible liquid.

**HPM ROOM.** A room used in conjunction with or serving a Group H-5 occupancy, where HPM is stored or used and which is classified as a Group H-2, H-3 or H-4 occupancy.

**IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH).** The concentration of airborne contaminants which poses a threat of death, immediate or delayed permanent adverse health effects, or effects that could prevent escape from such an environment. This contaminant concentration level is established by the National Institute of Occupational Safety and Health (NIOSH) based on both toxicity and flammability. It generally is expressed in parts per million by volume (ppm v/v) or milligrams per cubic meter (mg/m<sup>3</sup>). If adequate data do not exist for precise establishment of IDLH concentrations, an independent certified industrial hygienist, industrial toxicologist, appropriate regulatory agency or other source approved by the code official shall make such determination.

**LIQUID.** A material that has a melting point that is equal to or less than 20°C and a boiling point that is greater than 20°C at 101 kPa. When not otherwise identified, the term “liquid” includes both flammable and combustible liquids.

**LIQUID STORAGE ROOM.** A room classified as a Group H-3 occupancy used for the storage of flammable or combustible liquids in an unopened condition.

**LIQUID USE, DISPENSING AND MIXING ROOMS.** Rooms in which Class I, II and IIIA flammable or combustible liquids are used, dispensed or mixed in open containers.

**LOWER FLAMMABLE LIMIT (LFL).** The minimum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. The LFL is sometimes referred to as “LEL” or “lower explosive limit.”

**NORMAL TEMPERATURE AND PRESSURE (NTP).** A temperature of 21°C and a pressure of 101 kPa.

**SERVICE CORRIDOR.** A fully enclosed passage used for transporting HPM and purposes other than required means of egress.

**SOLID.** A material that has a melting point, decomposes or sublimates at a temperature greater than 20°C.

**STORAGE, HAZARDOUS MATERIALS.**

1. The keeping, retention or leaving of hazardous materials in closed containers, tanks, cylinders or similar vessels, or
2. Vessels supplying operations through closed connections to the vessel.

**USE (MATERIAL).** Placing a material into action, including solids, liquids and gases.

**WORKSTATION.** A defined space or an independent principal piece of equipment using HPM within a fabrication area where a specific function, laboratory procedure or research activity occurs. Approved or listed hazardous materials storage cabinets, flammable liquid storage cabinets or gas cabinets serving a workstation are included as part of the workstation. A workstation is allowed to contain ventilation equipment, fire protection devices, detection devices, electrical devices and other processing and scientific equipment.

**2B.15.3 Location on property.** Group H shall be located on property in accordance with the other provisions of this chapter. In Group H-2 or H-3, not less than 25 percent of the perimeter wall of the occupancy shall be an exterior wall.

**Exceptions:**

1. Liquid use, dispensing and mixing rooms having a floor area of not more than 46.5 m<sup>2</sup> need not be located on the outer perimeter of the building where they are in accordance with these code requirements and NFPA 30.
2. Liquid storage rooms having a floor area of not more than 93 m<sup>2</sup> need not be located on the outer perimeter where they are in accordance with these code requirements and NFPA 30.
3. Spray paint booths that comply with these code requirements need not be located on the outer perimeter.

**2B.15.3.1 Group H minimum distance to lot lines.** Regardless of any other provisions, buildings containing Group H occupancies shall be set back a minimum distance from lot lines as set forth in Items 1 through 4 below. Distances shall be measured from the walls enclosing the occupancy to lot lines, including those on a public way. Distances to assumed property lines drawn for the purposes of determination of exterior wall and opening protection are not to be used to establish the minimum distance for separation of buildings on sites where explosives are manufactured or used when separation is provided in accordance with the quantity distance tables specified for explosive materials in these code requirements.

1. Group H-1. Not less than 23 m and not less than required by these code requirements.

**Exceptions:**

1. Fireworks manufacturing buildings separated in accordance with NFPA 1124.
2. Buildings containing the following materials when separated in accordance

with Table 2B.15.3.1:

- 2.1 Organic peroxides, unclassified detonable.
- 2.2 Unstable reactive materials Class 4.
- 2.3 Unstable reactive materials, Class 3 detonable.
- 2.4 Detonable pyrophoric materials.
2. Group H-2. Not less than 9.1 m where the area of the occupancy exceeds 93 m<sup>2</sup> and it is not required to be located in a detached building.
3. Groups H-2 and H-3. Not less than 15.3 m where a detached building is required (see Table 2B.15.3.2).
4. Groups H-2 and H-3. Occupancies containing materials with explosive characteristics shall be separated as required by these code requirements. Where separations are not specified, the distances required shall not be less than the distances required by Table 2B.15.3.1.

**TABLE 2B.15.3.1**  
**MINIMUM SEPARATION DISTANCES FOR BUILDINGS CONTAINING EXPLOSIVE MATERIALS**

<b>QUANTITY OF EXPLOSIVE MATERIAL<sup>a</sup></b>		<b>MINIMUM DISTANCE (meters)</b>		
		<b>Lot lines<sup>b</sup> and inhabited buildings<sup>c</sup></b>		<b>Separation of magazines<sup>d,e,f</sup></b>
<b>Kilograms over</b>	<b>Kilograms not over</b>	<b>Barricaded<sup>d</sup></b>	<b>Unbarricaded</b>	
0.9	2.3	21	43	3.7
2.3	4.5	27	55	4.9
4.5	9.1	34	67	6.1
9.1	13.6	38	76	6.7
13.6	18.2	43	85	7.3
18.2	22.7	46	91	8.5
22.7	34.1	52	104	9.1
34.1	45.4	58	116	9.8
45.4	56.8	61	122	11
56.8	68.1	66	131	11.6
68.1	90.8	72	143	12.8
90.8	113.5	78	155	14
113.5	136.2	82	165	14.6
136.2	181.6	90	180	16.5
181.6	227.0	98	195	17.7
227.0	272.4	104	207	19
272.4	317.8	108	216	19.5
317.8	363.2	114	229	20
363.2	408.6	119	238	21
408.6	454.0	122	244	22
454.0	544.8	130	259	24
544.8	635.6	137	274	25
635.6	726.4	143	287	26
726.4	817.2	149	299	27
817.2	454	154	308	27
908	1,135	166	332	30
1,135	1,362	177	354	32
1,362	1,816	194	387	35
1,816	2,270	209	418	37
2,270	2,724	223	445	40
2,724	3,178	235	469	41
3,178	3,632	244	488	44
3,632	4,086	255	509	46
4,086	4,540	264	527	48
4,540	5,448	267	533	50

(Continued)

**TABLE 2B.15.3.1—Continued**  
**MINIMUM SEPARATION DISTANCES FOR BUILDINGS CONTAINING EXPLOSIVE MATERIALS**

QUANTITY OF EXPLOSIVE MATERIAL <sup>a</sup>		MINIMUM DISTANCE (meters)		
Kilograms over	Kilograms not over	Lot lines <sup>b</sup> and inhabited buildings <sup>c</sup>		Separation of magazines <sup>d, e, f</sup>
		Barricaded <sup>d</sup>	Unbarricaded	
5,448	6,356	270	539	53
6,356	7,264	274	549	55
7,264	8,172	287	573	57
8,172	9,080	297	594	60
9,080	11,350	322	610	64
11,350	13,620	344	610	68
13,620	15,890	367	610	73
15,890	18,160	389	610	76
18,160	20,430	408	610	79
20,430	22,700	427	610	82
22,700	24,970	445	610	85
24,970	27,240	462	610	88
27,240	29,510	477	610	91
29,510	31,780	491	610	94
31,780	34,050	504	610	98
34,050	36,320	517	610	101
36,320	38,590	527	610	104
38,590	40,860	536	610	107
40,860	43,130	546	610	110
43,130	45,400	553	610	113
45,400	49,940	559	610	119
49,940	54,480	565	610	125
54,480	59,020	572	610	131
59,020	63,560	576	610	137
63,560	68,100	579	610	143
68,100	72,640	590	610	149
72,640	77,180	599	610	155
77,180	81,720	607	610	162
81,720	86,260	613	613	168
86,260	90,800	619	619	174
90,800	95,340	626	626	180
95,340	104,420	640	640	192
104,420	113,500	657	657	204
113,500	124,850	675	675	219
124,850	136,200	693	693	235

- a. The number of kilograms of explosives listed is the number of pounds of trinitrotoluene (TNT) or the equivalent kilograms of other explosive.
- b. The distance listed is the distance to lot line, including lot lines at public ways.
- c. For the purpose of this table, an inhabited building is any building on the same property that is regularly occupied by people. Where two or more buildings containing explosives or magazines are located on the same property, each building or magazine shall comply with the minimum distances specified from inhabited buildings and, in addition, they shall be separated from each other by not less than the distance shown for "Separation of magazines," except that the quantity of explosive materials contained in detonator buildings or magazines shall govern in regard to the spacing of said buildings or magazines from buildings or magazines, as a group, shall be considered as one building or magazine, and the total quantity of explosive materials stored in such group shall be treated as if the explosive were in a single building or magazine located on the site of any building or magazine of the group, and shall comply with the minimum distance specified from other magazines or inhabited buildings.
- d. Barricades shall effectively screen the building containing explosives from other buildings, public ways or magazines. Where mounds or reverted walls of earth are used for barricades, they shall not be less than 0.9 meter in thickness. A straight line from the top of any side wall of the building containing explosive materials to the eave line of any other building, magazine or a point 3.7 meters. Above the centerline of a public way shall pass through the barricades.
- e. Magazine is a building or structure, other than an operating building, approved for storage of explosive materials. Portable or mobile magazines not exceeding 11 m<sup>2</sup> in area need not comply with the requirements of SBC 201, however, all magazines shall comply with these code requirements.
- f. The distance listed is permitted be reduced by 50 percent where approved natural or artificial barriers are provided in accordance with the requirements in Note d.

**2B.15.3.2 Group H-1 and H-2 or H-3 detached buildings.** Where a detached building is required by Table 2B.15.3.2, there are no requirements for wall and opening protection based on location on property.

**TABLE 2B.15.3.2  
REQUIRED DETACHED STORAGE**

<b>DETACHED STORAGE IS REQUIRED WHEN THE QUANTITY OF MATERIAL EXCEEDS THAT LISTED HEREIN</b>			
<b>Material</b>	<b>Class</b>	<b>Solids and Liquids (tonnes)<sup>a,b</sup></b>	<b>Gases (cubic meters)<sup>a,b</sup></b>
Explosives	Division 1.1	Maximum Allowable Quantity	Not Applicable
	Division 1.2	Maximum Allowable Quantity	
	Division 1.3	Maximum Allowable Quantity	
	Division 1.4	Maximum Allowable Quantity	
	Division 1.4 <sup>c</sup>	0.907	
	Division 1.5	Maximum Allowable Quantity	
	Division 1.7	Maximum Allowable Quantity	
Oxidizers	Class 4	Maximum Allowable Quantity	Maximum Allowable Quantity
Unstable (reactives) detonable	Class 3 or 4	Maximum Allowable Quantity	Maximum Allowable Quantity
Oxidizer, liquids and solids	Class 3	1,089	Not Applicable
	Class 2	1,814	Not Applicable
Organic peroxides	Detonable	Maximum Allowable Quantity	Not Applicable
	Class I	Maximum Allowable Quantity	Not Applicable
	Class II	22.7	Not Applicable
	Class III	45.4	Not Applicable
Unstable (reactives) nondetonable	Class 3	0.907	57
	Class 2	22.7	283
Water reactives	Class 3	0.907	Not Applicable
	Class 2	22.7	Not Applicable
Pyrophoric gases	Not Applicable	Not Applicable	57

- For materials that are detonable, the distance to other buildings or lot lines shall be as specified in Table 2B.15.3.1 based on trinitrotoluene (TNT) equivalence of the material. For materials classified as explosives, see Chapter 31. For all other materials, the distance shall be as indicated in Section 2B.15.3.1.
- Maximum Allowable Quantity” means the maximum allowable quantity per control area set forth in Table 2A.7.7(1).
- Limited to Division 1.4 materials and articles, including articles packaged for shipment, that are not regulated as an explosive under MOI (Bureau of Alcohol, Tobacco and Firearms (BATF)) regulations or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, providing the net explosive weight of individual articles does not exceed 0.5 kilograms.

**2B.15.4 Special provisions for Group H-1 occupancies.** Group H-1 occupancies shall be in buildings used for no other purpose, shall not exceed one story in height and be without basement, crawl spaces or other under-floor spaces. Roofs shall be of lightweight construction with suitable thermal insulation to prevent sensitive material from reaching its decomposition temperature.

Group H-1 occupancies containing materials which are in themselves both physical and health hazards in quantities exceeding the maximum allowable quantities per control area in Table 2A.7.7(2) shall comply with requirements for both Group H-1 and H-4 occupancies.

**2B.15.4.1 Floors in storage rooms.** Floors in storage areas for organic peroxides, pyrophoric materials and unstable (reactive) materials shall be of liquid-tight, noncombustible construction.



- 2B.15.5 Special provisions for Group H-2 and H-3 occupancies.** Group H-2 and H-3 occupancies containing quantities of hazardous materials in excess of those set forth in Table 2B.15.3.2 shall be in buildings used for no other purpose, shall not exceed one story in height and shall be without basements, crawl spaces or other under-floor spaces.
- Group H-2 and H-3 occupancies containing water-reactive materials shall be resistant to water penetration. Piping for conveying liquids shall not be over or through areas containing water reactives, unless isolated by approved liquid-tight construction.
- Exception:** Fire protection piping.
- 2B.15.5.1 Floors in storage rooms.** Floors in storage areas for organic peroxides, oxidizers, pyrophoric materials, unstable (reactive) materials and water-reactive solids and liquids shall be of liquid-tight, noncombustible construction.
- 2B.15.5.2 Waterproof room.** Rooms or areas used for the storage of water-reactive solids and liquids shall be constructed in a manner that resists the penetration of water through the use of waterproof materials. Piping carrying water for other than approved automatic fire sprinkler systems shall not be within such rooms or areas.
- 2B.15.6 Smoke and heat venting.** Smoke and heat vents complying with Section 7.10 shall be installed in the following locations:
1. In occupancies classified as Group H-2 or H-3, any of which are over 1,394 m<sup>2</sup> in single floor area.  
**Exception:** Buildings of noncombustible construction containing only noncombustible materials.
  2. In areas of buildings in Group H used for storing Class 2, 3 and 4 liquid and solid oxidizers, Class 1 and unclassified detonable organic peroxides, Class 3 and 4 unstable (reactive) materials, or Class 2 or 3 water-reactive materials as required for a Class V hazard classification.  
**Exception:** Buildings of noncombustible construction containing only noncombustible materials.
- 2B.15.7 Group H-2.** Occupancies in Group H-2 shall be constructed in accordance with Sections 2B.15.7.1 through 2B.15.7.4 and this code.
- 2B.15.7.1 Combustible dusts, grain processing and storage.** The provisions of Sections 2B.15.7.1.1 through 2B.15.7.1.5 shall apply to buildings in which materials that produce combustible dusts are stored or handled. Buildings that store or handle combustible dusts shall comply with the applicable provisions of NFPA 61, NFPA 120, NFPA 651, NFPA 654, NFPA 655, NFPA 664 and NFPA 85, and this code.
- 2B.15.7.1.1 Type of construction and height exceptions.** Buildings shall be constructed in compliance with the height and area limitations of Chapter 3 for Group H-2; except that where erected of Type I or II construction, the heights and areas of grain elevators and similar structures shall be unlimited, and where of Type IV construction, the maximum height shall be 20 m and except further that, in isolated areas, the maximum height of Type IV structures shall be increased to 26 m.
- 2B.15.7.1.2 Grinding rooms.** Every room or space occupied for grinding or other operations that produce combustible dusts shall be enclosed with fire barriers and horizontal assemblies or both that have not less than a 2 hours fire-resistance rating where the area is not more than 279 m<sup>2</sup>, and not less than a 4-hour fire-resistance rating where the area is greater than 279 m<sup>2</sup>.
- 2B.15.7.1.3 Conveyors.** Conveyors, chutes, piping and similar equipment passing through the enclosures of rooms or spaces shall be constructed dirt tight and vapor tight, and be of approved noncombustible materials complying with SBC 501.

- 2B.15.7.1.4 Explosion control.** Explosion control shall be provided as specified in these code requirements, or spaces shall be equipped with the equivalent mechanical ventilation complying with the SBC 501.
- 2B.15.7.1.5 Grain elevators.** Grain elevators, non-alcoholic malt houses and buildings for similar occupancies shall not be located within 9.1 m of interior lot lines or structures on the same lot, except where erected along a railroad right-of-way.
- 2B.15.7.1.6 Coal pockets.** Coal pockets located less than 9.1 m from interior lot lines or from structures on the same lot shall be constructed of not less than Type IB construction. Where more than 9.1 m from interior lot lines, or where erected along a railroad right-of-way, the minimum type of construction of such structures not more than 20 m in height shall be Type IV.
- 2B.15.7.2 Flammable and combustible liquids.** The storage, handling, processing and transporting of flammable and combustible liquids shall be in accordance with the SBC 501 and these code requirements.
- 2B.15.7.2.1 Mixed occupancies.** Where the storage tank area is located in a building of two or more occupancies, and the quantity of liquid exceeds the maximum allowable quantity for one control area, the use shall be completely separated from adjacent fire areas in accordance with the requirements of Section 2A.2.3.2.
- 2B.15.7.2.1.1 Height exception.** Where storage tanks are located within only a single-story building, the height limitation of Section 3.3 shall not apply for Group H.
- 2B.15.7.2.2 Tank protection.** Storage tanks shall be noncombustible and protected from physical damage. A fire barrier wall or horizontal assemblies or both around the storage tank(s) shall be permitted as the method of protection from physical damage.
- 2B.15.7.2.3 Tanks.** Storage tanks shall be approved tanks conforming to the requirements of these code requirements.
- 2B.15.7.2.4 Suppression.** Group H shall be equipped throughout with an approved automatic sprinkler system, installed in accordance with Section 7.3.
- 2B.15.7.2.5 Leakage containment.** A liquid-tight containment area compatible with the stored liquid shall be provided. The method of spill control, drainage control and secondary containment shall be in accordance with this code.  
**Exception:** Rooms where only double-wall storage tanks conforming to Section 2B.15.7.2.3 are used to store Class I, II and IIIA flammable and combustible liquids shall not be required to have a leakage containment area.
- 2B.15.7.2.6 Leakage alarm.** An approved automatic alarm shall be provided to indicate a leak in a storage tank and room. The alarm shall sound an audible signal, 15 dBA above the ambient sound level, at every point of entry into the room in which the leaking storage tank is located. An approved sign shall be posted on every entry door to the tank storage room indicating the potential hazard of the interior room environment, or the sign shall state: WARNING, WHEN ALARM SOUNDS, THE ENVIRONMENT WITHIN THE ROOM MAY BE HAZARDOUS. The leakage alarm shall also be supervised in accordance with Chapter 9 to transmit a trouble signal.
- 2B.15.7.2.7 Tank vent.** Storage tank vents for Class I, II or IIIA liquids shall terminate to the outdoor air in accordance with these code requirements.
- 2B.15.7.2.8 Room ventilation.** Storage tank areas storing Class I, II or IIIA liquids shall be provided with mechanical ventilation. The mechanical ventilation system shall be in accordance with the SBC 501 and these code requirements.
- 2B.15.7.2.9 Explosion venting.** Where Class I liquids are being stored, explosion venting shall be provided in accordance with this code.



- 2B.15.7.2.10 Tank openings other than vents.** Tank openings other than vents from tanks inside buildings shall be designed to ensure that liquids or vapor concentrations are not released inside the building.
- 2B.15.7.3 Liquefied petroleum gas-distribution facilities.** The design and construction of propane, butane, propylene, butylene and other liquefied petroleum gas-distribution facilities shall conform to the applicable provisions of Sections 2B.15.7.3.1 through 2B.15.7.3.5.2. The storage and handling of liquefied petroleum gas systems shall conform to these code requirements. The design and installation of piping, equipment and systems that utilize liquefied petroleum gas shall be in accordance with and approved method. Liquefied petroleum gas-distribution facilities shall be ventilated in accordance with the SBC 501 and Section 2B.15.7.3.1.
- 2B.15.7.3.1 Air movement.** Liquefied petroleum gas-distribution facilities shall be provided with air inlets and outlets arranged so that air movement across the floor of the facility will be uniform. The total area of both inlet and outlet openings shall be at least  $645 \text{ mm}^2$  for each  $0.093 \text{ m}^2$  of floor area. The bottom of such openings shall not be more than 152 mm above the floor.
- 2B.15.7.3.2 Construction.** Liquefied petroleum gas-distribution facilities shall be constructed in accordance with Section 2B.15.7.3.3 for separate buildings, Section 2B.15.7.3.4 for attached buildings or Section 2B.15.7.3.5 for rooms within buildings.
- 2B.15.7.3.3 Separate buildings.** Where located in separate buildings, liquefied petroleum gas-distribution facilities shall be occupied exclusively for that purpose or for other purposes having similar hazards. Such buildings shall be limited to one story in height and shall conform to Sections 2B.15.7.3.3.1 through 2B.15.7.3.3.3.
- 2B.15.7.3.3.1 Floors.** The floor shall not be located below ground level and any spaces beneath the floor shall be solidly filled or shall be unenclosed.
- 2B.15.7.3.3.2 Materials.** Walls, floors, ceilings, columns and roofs shall be constructed of noncombustible materials.
- 2B.15.7.3.3.3 Explosion venting.** Explosion venting shall be provided in accordance with these code requirements.
- 2B.15.7.3.4 Attached buildings.** Where liquefied petroleum gas-distribution facilities are located in an attached structure, the attached perimeter shall not exceed 50 percent of the perimeter of the space enclosed and the facility shall comply with Sections 2B.15.7.3.3 and 2B.15.7.3.4.1. Where the attached perimeter exceeds 50 percent, such facilities shall comply with Section 2B.15.7.3.5.
- 2B.15.7.3.4.1 Fire separation assemblies.** Separation of the attached structures shall be provided by fire barrier walls and horizontal assemblies, or both, having a fire-resistance rating of not less than 1 hour and shall not have openings. Fire barrier walls and horizontal assemblies, or both, between attached structures occupied only for the storage of LP-gas are permitted to have fire doors that comply with Section 4B.14. Such fire barrier walls and horizontal assemblies, or both, shall be designed to withstand a static pressure of at least 4,788 Pa, except where the building to which the structure is attached is occupied by operations or processes having a similar hazard.
- 2B.15.7.3.5 Rooms within buildings.** Where liquefied petroleum gas-distribution facilities are located in rooms within buildings, such rooms shall be located in the first story above grade plane and shall have at least one exterior wall with sufficient exposed area to provide explosion venting as required in these code requirements. The building in which the room is located shall not have a basement or unventilated crawl space and the room shall comply with Sections 2B.15.7.3.5.1 and 2B.15.7.3.5.2.

**2B.15.7.3.5.1 Materials.** Walls, floors, ceilings and roofs of such rooms shall be constructed by an approved noncombustible materials.

**2B.15.7.3.5.2 Common construction.** Walls and floor/ceiling assemblies common to the room and to the building within which the room is located shall have a fire barrier wall and horizontal assembly or both of not less than 1 hour and without openings. Common walls for rooms occupied only for storage of LP-gas are permitted to have opening protectives complying with Section 4B.14. Such walls and ceiling shall be designed to withstand a static pressure of at least 4,788 Pa.

**Exception:** Where the building, within which the room is located, is occupied by operations or processes having a similar hazard.

**2B.15.7.4 Dry cleaning plants.** The construction and installation of dry cleaning plants shall be in accordance with the requirements of these code requirements, the SBC 501, the SBC 701 and NFPA 32. Dry cleaning solvents and systems shall be classified in accordance with this code.

**2B.15.8 Groups H-3 and H-4.** Groups H-3 and H-4 shall be constructed in accordance with the applicable provisions of these code requirements.

**2B.15.8.1 Gas rooms.** When gas rooms are provided, such rooms shall be separated from other areas by not less than a 1-hour fire barrier.

**2B.15.8.2 Floors in storage rooms.** Floors in storage areas for corrosive liquids and highly toxic or toxic materials shall be of liquid-tight, noncombustible construction.

**2B.15.8.3 Separation—highly toxic solids and liquids.** Highly toxic solids and liquids not stored in approved hazardous materials storage cabinets shall be isolated from other hazardous materials storage by construction having a 1-hour fire-resistance rating.

**2B.15.9 Group H-5.**

**2B.15.9.1 General.** In addition to the requirements set forth elsewhere in these code requirements, Group H-5 shall comply with the provisions of Section 2B.15.9 and other code requirements.

**2B.15.9.2 Fabrication areas.**

**2B.15.9.2.1 Hazardous materials in fabrication areas.**

**2B.15.9.2.1.1 Aggregate quantities.** The aggregate quantities of hazardous materials stored and used in a single fabrication area shall not exceed the quantities set forth in Table 2B.15.9.2.1.1.

**Exception:** The quantity limitations for any hazard category in Table 2B.15.9.2.1.1 shall not apply where the fabrication area contains quantities of hazardous materials not exceeding the maximum allowable quantities per control area established by Tables 2A.7.7(1) and 2A.7.7(2).

**2B.15.9.2.1.2 Hazardous production materials.** The maximum quantities of hazardous production materials stored in a single fabrication area shall not exceed the maximum allowable quantities per control area established by Tables 2A.7.7(1) and 2A.7.7(2).

**2B.15.9.2.2 Separation.** Fabrication areas, whose sizes are limited by the quantity of hazardous materials allowed by Table 2B.15.9.2.1.1, shall be separated from each other, from exit access corridors, and from other parts of the building by not less than 1-hour fire barriers.

**Exceptions:**

1. Doors within such fire barrier walls, including doors to corridors, shall be only self-closing fire assemblies having a fire-protection rating of not less than  $\frac{3}{4}$  hour.
2. Windows between fabrication areas and exit access corridors are permitted to

be fixed glazing listed and labeled for a fire protection rating of at least  $\frac{3}{4}$  hour in accordance with Section 4B.14.

**TABLE 2B.15.9.2.1.1**  
**QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA**  
**IN GROUP H-5<sup>a</sup>**

HAZARD CATEGORY		SOLIDS (kg / m <sup>2</sup> )	LIQUIDS (liters / m <sup>2</sup> )	GAS (m <sup>3</sup> @ NTP/m <sup>2</sup> )
<b>PHYSICAL-HAZARD MATERIALS</b>				
Combustible dust		Note b	Not Applicable	Not Applicable
Combustible fiber	Loose Baled	Note b Note b	Not Applicable	Not Applicable
Combustible liquid	II IIIA IIIB	Not Applicable	0.00025 0.0005 Not Limited 0.001	Not Applicable
Combination Class I, II and IIIA				
Cryogenic gas	Flammable Oxidizing	Not Applicable	Not Applicable	Note c 0.38
Explosives		Note b	Note b	Note b
Flammable gas	Gaseous Liquefied	Not Applicable	Not Applicable	Note b Note c
Flammable liquid	A IB IC	Not Applicable	0.00006 0.00063 0.00063 0.00063 0.001	Not Applicable
Combination Class IA, IB and IC Combination Class I, II and IIIA				
Flammable solid		0.005	Not Applicable	Not Applicable
Organic peroxide	Unclassified detonable Class I Class II Class III Class IV Class V	Note b Note b 0.122 0.488 Not Limited Not limited	Not Applicable	Not Applicable
Oxidizing gas	Gaseous Liquefied	Not Applicable	Not Applicable	0.38 0.38 0.38
Combination of gaseous and liquefied				
Oxidizer	Class 4 Class 3 Class 2 Class 1	Note b 0.015 0.015 0.015	Note b 0.00008 0.00008 0.00008	Not Applicable
Combination	Class 1, 2, 3	0.015	0.00008	
Pyrophoric material		Note b	0.00003	Notes c and d
Unstable reactive	Class 4 Class 3 Class 2 Class 1	Note b 0.122 0.488 Not Limited	Note b 0.00006 0.00025 Not Limited	Note b Note b Note b Not Limited
Water reactive	Class 3 Class 2 Class 1	Note b 1.22 Not Limited	0.00003 0.00063 Not Limited	Not Applicable
<b>HEALTH-HAZARD MATERIALS</b>				
Corrosives		Not Limited	Not Limited	Not Limited
Highly toxic		Not Limited	Not Limited	Note c
Toxics		Not Limited	Not Limited	Note c

- a. Hazardous materials within piping shall not be included in the calculated quantities.  
b. Quantity of hazardous materials in a single fabrication shall not exceed the maximum allowable quantities per control area in Tables 2A.7.7(1) and 2A.7.7(2).  
c. The aggregate quantity of flammable, pyrophoric, toxic and highly toxic gases shall not exceed 255 cubic meters at NTP.  
d. The aggregate quantity of pyrophoric gases in the building shall not exceed the amounts set forth in Table 2B.15.3.2.

**2B.15.9.2.3 Location of occupied levels.** Occupied levels of fabrication areas shall be located at or above the first story above grade plane.

**2B.15.9.2.4 Floors.** Except for surfacing, floors within fabrication areas shall be of noncombustible construction.

Openings through floors of fabrication areas are permitted to be unprotected where the interconnected levels are used solely for mechanical equipment directly related to such fabrication areas (see also Section 2B.15.9.2.5).

Floors forming a part of an occupancy separation shall be liquid tight.

**2B.15.9.2.5 Shafts and openings through floors.** Elevator shafts, vent shafts and other openings through floors shall be enclosed when required by Section 4B.7. Mechanical, duct and piping penetrations within a fabrication area shall not extend through more than two floors. The annular space around penetrations for cables, cable trays, tubing, piping, conduit or ducts shall be sealed at the floor level to restrict the movement of air. The fabrication area, including the areas through which the ductwork and piping extend, shall be considered a single conditioned environment.

**2B.15.9.2.6 Ventilation.** Mechanical exhaust ventilation shall be provided throughout the fabrication area at the rate of not less than  $0.044 \text{ L/S/m}^2$  of floor area. The exhaust air duct system of one fabrication area shall not connect to another duct system outside that fabrication area within the building.

A ventilation system shall be provided to capture and exhaust fumes and vapors at workstations.

Two or more operations at a workstation shall not be connected to the same exhaust system where either one or the combination of the substances removed could constitute a fire, explosion or hazardous chemical reaction within the exhaust duct system.

Exhaust ducts penetrating occupancy separations shall be contained in a shaft of equivalent fire-resistance construction. Exhaust ducts shall not penetrate fire walls. Fire dampers shall not be installed in exhaust ducts.

**2B.15.9.2.7 Transporting hazardous production materials to fabrication areas.** Hazardous production materials shall be transported to fabrication areas through enclosed piping or tubing systems that comply with Section 2B.15.9.6.1, through service corridors complying with Section 2B.15.9.4, or in exit access corridors as permitted in the exception to Section 2B.15.9.3. The handling or transporting of hazardous production materials within service corridors shall comply with these code requirements.

**2B.15.9.2.8 Electrical.**

**2B.15.9.2.8.1 General.** Electrical equipment and devices within the fabrication area shall comply with the SBC 401. The requirements for hazardous locations need not be applied where the average air change is at least four times that set forth in Section 2B.15.9.2.6 and where the number of air changes at any location is not less than three times that required by Section 2B.15.9.2.6. The use of re-circulated air shall be permitted.

**2B.15.9.2.8.2 Workstations.** Workstations shall not be energized without adequate exhaust ventilation. See Section 2B.15.9.2.6 for workstation exhaust ventilation requirements.

**2B.15.9.3 Exit access corridors.** Exit access corridors shall comply with Chapter 8 and shall be separated from fabrication areas as specified in Section 2B.15.9.2.2. Exit access corridors shall not contain HPM and shall not be used for transporting such materials, except through closed piping systems as provided in Section 2B.15.9.6.3.

**Exception:** Where existing fabrication areas are altered or modified, HPM is allowed to be transported in existing exit access corridors, subject to the following conditions:

**1. Corridors.** Exit access corridors adjacent to the fabrication area where the

alteration work is to be done shall comply with Section 8.16 for a length determined as follows:

- 1.1 The length of the common wall of the corridor and the fabrication area; and
- 1.2 For the distance along the exit access corridor to the point of entry of HPM into the exit access corridor serving that fabrication area.
2. **Emergency alarm system.** There shall be an emergency telephone system, a local manual alarm station or other approved alarm-initiating device within exit access corridors at not more than 46 m intervals and at each exit and exit access doorway. The signal shall be relayed to an approved central, proprietary or remote station service or the emergency control station and shall also initiate a local audible alarm.
3. **Pass-throughs.** Self-closing doors having a fire-protection rating of not less than 1 hour shall separate pass-throughs from existing exit access corridors. Pass-throughs shall be constructed as required for the exit access corridors, and protected by an approved automatic fire-extinguishing system.

#### 2B.15.9.4 **Service corridors.**

2B.15.9.4.1 **Occupancy.** Service corridors shall be classified as Group H-5.

2B.15.9.4.2 **Use conditions.** Service corridors shall be separated from exit access corridors as required by Section 2B.15.9.2.2. Service corridors shall not be used as a required exit access corridor.

2B.15.9.4.3 **Mechanical ventilation.** Service corridors shall be mechanically ventilated as required by Section 2B.15.9.2.6 or at not less than six air changes per hour, whichever is greater.

2B.15.9.4.4 **Means of egress.** The maximum distance of travel from any point in a service corridor to an exit, exit access corridor or door into a fabrication area shall not exceed 23 m. Dead ends shall not exceed 1.22 m in length. There shall be not less than two exits, and not more than one-half of the required means of egress shall require travel into a fabrication area. Doors from service corridors shall swing in the direction of egress travel and shall be self-closing.

2B.15.9.4.5 **Minimum width.** The minimum clear width of a service corridor shall be 1.5 m, or 838 mm wider than the widest cart or truck used in the corridor, whichever is greater.

2B.15.9.4.6 **Emergency alarm system.** Emergency alarm systems shall be provided in accordance with this section and Sections 2B.14.7.1 and 2B.14.7.2. The maximum allowable quantity per control area provisions shall not apply to emergency alarm systems required for HPM.

2B.15.9.4.6.1 **Service corridors.** An emergency alarm system shall be provided in service corridors, with at least one alarm device in each service corridor.

2B.15.9.4.6.2 **Exit access corridors and exit enclosures.** Emergency alarms for exit access corridors and exit enclosures shall comply with Section 2B.14.7.2.

2B.15.9.4.6.3 **Liquid storage rooms, HPM rooms and gas rooms.** Emergency alarms for liquid storage rooms, HPM rooms and gas rooms shall comply with Section 2B.14.7.1.

2B.15.9.4.6.4 **Alarm-initiating devices.** An approved emergency telephone system, local alarm manual pull stations, or other approved alarm-initiating devices are allowed to be used as emergency alarm-initiating devices.

2B.15.9.4.6.5 **Alarm signals.** Activation of the emergency alarm system shall sound a local alarm and transmit a signal to the emergency control station.



**2B.15.9.5 Storage of hazardous production materials.**

**2B.15.9.5.1 General.** Storage of HPM in fabrication areas shall be within approved or listed storage cabinets or gas cabinets, or within a workstation. The storage of hazardous production materials in quantities greater than those listed in Tables 2A.7.7(1) or 2A.7.7(2) shall be in liquid storage rooms, HPM rooms or gas rooms as appropriate for the materials stored. The storage of other hazardous materials shall be in accordance with other applicable provisions of these code requirements and these code requirements.

**2B.15.9.5.2 Construction.**

**2B.15.9.5.2.1 HPM rooms and gas rooms.** HPM rooms and gas rooms shall be separated from other areas by not less than a 2 hours fire barrier where the area is  $27.9 \text{ m}^2$  or more and not less than a 1 hour fire barrier where the area is less than  $27.9 \text{ m}^2$ .

**2B.15.9.5.2.2 Liquid storage rooms.** Liquid storage rooms shall be constructed in accordance with the following requirements:

1. Rooms in excess of  $46.5 \text{ m}^2$  shall have at least one exterior door approved for Civil Defence access.
2. Rooms shall be separated from other areas by fire barriers having a fire-resistance rating of not less than 1 hour for rooms up to  $13.9 \text{ m}^2$  in area and not less than 2 hours where the room is more than  $13.9 \text{ m}^2$  in area.
3. Shelving, racks and wainscoting in such areas shall be of noncombustible construction or wood of not less than 25 mm nominal thickness.
4. Rooms used for the storage of Class I flammable liquids shall not be located in a basement.

**2B.15.9.5.2.3 Floors.** Except for surfacing, floors of HPM rooms and liquid storage rooms shall be of noncombustible liquid-tight construction. Raised grating over floors shall be of noncombustible materials.

**2B.15.9.5.3 Location.** Where HPM rooms, liquid storage rooms and gas rooms are provided, they shall have at least one exterior wall and such wall shall be not less than 9.1 m from property lines, including property lines adjacent to public ways.

**2B.15.9.5.4 Explosion control.** Explosion control shall be provided where required by Section 2B.14.5.1.

**2B.15.9.5.5 Exits.** Where two exits are required from HPM rooms, liquid storage rooms and gas rooms, one shall be directly to the outside of the building.

**2B.15.9.5.6 Doors.** Doors in a fire barrier wall, including doors to corridors, shall be self-closing fire assemblies having a fire-protection rating of not less than 3/4 hour.

**2B.15.9.5.7 Ventilation.** Mechanical exhaust ventilation shall be provided in liquid storage rooms, HPM rooms and gas rooms at the rate of not less than  $0.044 \text{ L/S/m}^2$  of floor area or six air changes per hour, whichever is greater, for categories of material. Exhaust ventilation for gas rooms shall be designed to operate at a negative pressure in relation to the surrounding areas and direct the exhaust ventilation to an exhaust system.

**2B.15.9.5.8 Emergency alarm system.** An approved emergency alarm system shall be provided for HPM rooms, liquid storage rooms and gas rooms.

1. Emergency alarm-initiating devices shall be installed outside of each interior exit door of such rooms. Activation of an emergency alarm-initiating device shall sound a local alarm and transmit a signal to the emergency control station.
2. An approved emergency telephone system, local alarm manual pull stations or other approved alarm-initiating devices are allowed to be used as emergency alarm-initiating devices.

**2B.15.9.6 Piping and tubing.**

**2B.15.9.6.1 General.** Hazardous production materials piping and tubing shall comply with this section and ANSI B31.3.

**2B.15.9.6.2 Supply piping and tubing.**

**2B.15.9.6.2.1 HPM having a health-hazard ranking of 3 or 4.** Systems supplying HPM liquids or gases having a health-hazard ranking of 3 or 4 shall be welded throughout, except for connections, to the systems that are within a ventilated enclosure if the material is a gas, or an approved method of drainage or containment is provided for the connections if the material is a liquid.

**2B.15.9.6.2.2 Location in service corridors.** Hazardous production materials supply piping or tubing in service corridors shall be exposed to view.

**2B.15.9.6.2.3 Excess flow control.** Where HPM gases or liquids are carried in pressurized piping above 103.4 kPa, excess flow control shall be provided. Where the piping originates from within a liquid storage room, HPM room or gas room, the excess flow control shall be located within the liquid storage room, HPM room or gas room. Where the piping originates from a bulk source, the excess flow control shall be located as close to the bulk source as practical.

**2B.15.9.6.3 Installations in exit access corridors and above other occupancies.** The installation of hazardous production material piping and tubing within the space defined by the walls of exit access corridors and the floor or roof above or in concealed spaces above other occupancies shall be in accordance with Section 2B.15.9.6.2 and the following conditions:

1. Automatic sprinklers shall be installed within the space unless the space is less than 152 mm in the least dimension.
2. Ventilation not less than six air changes per hour shall be provided. The space shall not be used to convey air from any other area.
3. Where the piping or tubing is used to transport HPM liquids, a receptor shall be installed below such piping or tubing. The receptor shall be designed to collect any discharge or leakage and drain it to an approved location. The 1-hour enclosure shall not be used as part of the receptor.
4. HPM supply piping and tubing and HPM nonmetallic waste lines shall be separated from the exit access corridor and from occupancies other than Group H-5 by construction as required for walls or partitions that have a fire protection rating of not less than 1 hour. Where gypsum wallboard is used, joints on the piping side of the enclosure are not required to be taped, provided the joints occur over framing members. Access openings into the enclosure shall be protected by approved fire-resistance-rated assemblies.
5. Readily accessible manual or automatic remotely activated fail-safe emergency shutoff valves shall be installed on piping and tubing other than waste lines at the following locations:
  - 5.1 At branch connections into the fabrication area.
  - 5.2 At entries into exit access corridors.

**Exception:** Transverse crossings of the corridors by supply piping that is enclosed within a ferrous pipe or tube for the width of corridor need not comply with Items 1 through 5.

**2B.15.9.6.4 Identification.** Piping, tubing and HPM waste lines shall be identified in accordance with ANSI A13.1 to indicate the material being transported.

**2B.15.9.7 Continuous gas-detection systems.** A continuous gas-detection system shall be provided for HPM gases when the physiological warning properties of the gas are at a higher level than the accepted permissible exposure limit (PEL) for the gas and for flammable gases in accordance with this section.

**2B.15.9.7.1 Where required.** A continuous gas-detection system shall be provided in the areas identified in Sections 2B.15.9.7.1.1 through 2B.15.9.7.1.4.

**2B.15.9.7.1.1 Fabrication areas.** A continuous gas-detection system shall be provided in fabrication areas when gas is used in the fabrication area.

**2B.15.9.7.1.2 HPM rooms.** A continuous gas-detection system shall be provided in HPM rooms when gas is used in the room.

**2B.15.9.7.1.3 Gas cabinets, exhausted enclosures and gas rooms.** A continuous gas-detection system shall be provided in gas cabinets and exhausted enclosures. A continuous gas-detection system shall be provided in gas rooms when gases are not located in gas cabinets or exhausted enclosures.

**2B.15.9.7.1.4 Exit access corridors.** When gases are transported in piping placed within the space defined by the walls of an exit access corridor, and the floor or roof above the exit access corridor, a continuous gas-detection system shall be provided where piping is located and in the exit access corridor.

**Exception:** A continuous gas-detection system is not required for occasional transverse crossings of the corridors by supply piping that is enclosed in a ferrous pipe or tube for the width of the corridor.

**2B.15.9.7.2 Gas-detection system operation.** The continuous gas-detection system shall be capable of monitoring the room, area or equipment in which the gas is located at or below the PEL or ceiling limit of the gas for which detection is provided. For flammable gases, the monitoring detection threshold level shall be vapor concentrations in excess of 20 percent of the lower explosive limit (LFL). Monitoring for highly toxic and toxic gases shall also comply with the requirements for such material in these code requirements.

**2B.15.9.7.2.1 Alarms.** The gas detection system shall initiate a local alarm and transmit a signal to the emergency control station when a short-term hazard condition is detected. The alarm shall be both visual and audible and shall provide warning both inside and outside the area where the gas is detected. The audible alarm shall be distinct from all other alarms.

**2B.15.9.7.2.2 Shutoff of gas supply.** The gas detection system shall automatically close the shutoff valve at the source on gas supply piping and tubing related to the system being monitored for which gas is detected when a short-term hazard condition is detected. Automatic closure of shutoff valves shall comply with the following:

1. Where the gas-detection sampling point initiating the gas detection system alarm is within a gas cabinet or exhausted enclosure, the shutoff valve in the gas cabinet or exhausted enclosure for the specific gas detected shall automatically close.
2. Where the gas-detection sampling point initiating the gas detection system alarm is within a room and compressed gas containers are not in gas cabinets or an exhausted enclosure, the shutoff valves on all gas lines for the specific gas detected shall automatically close.
3. Where the gas-detection sampling point initiating the gas detection system alarm is within a piping distribution manifold enclosure, the shutoff valve supplying the manifold for the compressed gas container of the specific gas detected shall automatically close.

**Exception:** Where the gas-detection sampling point initiating the gas detection system alarm is at the use location or within a gas valve enclosure of a branch line downstream of a piping distribution manifold, the shutoff valve for the branch line located in the piping distribution manifold enclosure shall automatically close.

**2B.15.9.8 Manual fire alarm system.** An approved manual fire alarm system shall be provided throughout buildings containing Group H-5. Activation of the alarm system shall initiate a local alarm and transmit a signal to the emergency control



station. The fire alarm system shall be designed and installed in accordance with Section 7.7.

**2B.15.9.9 Emergency control station.** An emergency control station shall be provided on the premises at an approved location, outside of the fabrication area and shall be continuously staffed by trained personnel. The emergency control station shall receive signals from emergency equipment and alarm and detection systems. Such emergency equipment and alarm and detection systems shall include, but not necessarily be limited to, the following where such equipment or systems are required to be provided either in Section 2B.15.9 or elsewhere in these code requirements:

1. Automatic fire sprinkler system alarm and monitoring systems.
2. Manual fire alarm systems.
3. Emergency alarm systems.
4. Continuous gas-detection systems.
5. Smoke detection systems.
6. Emergency power system.

**2B.15.9.10 Emergency power system.** An emergency power system shall be provided in Group H-5 occupancies where required in Section 2B.15.9.10.1. The emergency power system shall be designed to supply power automatically to required electrical systems when the normal electrical supply system is interrupted.

**2B.15.9.10.1 Where required.** Emergency power shall be provided for electrically operated equipment and connected control circuits for the following systems:

1. HPM exhaust ventilation systems.
2. HPM gas cabinet ventilation systems.
3. HPM exhausted enclosure ventilation systems.
4. HPM gas room ventilation systems.
5. HPM gas detection systems.
6. Emergency alarm systems.
7. Manual fire alarm systems.
8. Automatic sprinkler system monitoring and alarm systems.
9. Electrically operated systems required elsewhere in these code requirements applicable to the use, storage or handling of HPM.

**2B.15.9.10.2 Exhaust ventilation systems.** Exhaust ventilation systems are allowed to be designed to operate at not less than one-half the normal fan speed on the emergency power system where it is demonstrated that the level of exhaust will maintain a safe atmosphere.

**2B.15.9.11 Fire sprinkler system protection in exhaust ducts for HPM.**

**2B.15.9.11.1 General.** Automatic fire sprinkler system protection shall be provided in exhaust ducts conveying vapors, fumes, mists or dusts generated from HPM in accordance with this section and the SBC 501.

**2B.15.9.11.2 Metallic and noncombustible, nonmetallic exhaust ducts.** Automatic fire sprinkler system protection shall be provided in metallic and noncombustible, nonmetallic exhaust ducts where all of the following conditions apply:

1. Where the largest cross-sectional diameter is equal to or greater than 254 mm.
2. The ducts are within the building.
3. The ducts are conveying flammable vapors or fumes.

**2B.15.9.11.3 Combustible nonmetallic exhaust ducts.** Automatic fire sprinkler system protection shall be provided in combustible nonmetallic exhaust ducts where the largest cross-sectional diameter of the duct is equal to or greater than 254 mm.

**Exceptions:**

1. Ducts listed or approved for applications without automatic fire sprinkler

system protection.

2. Ducts not more than 3.7 m in length installed below ceiling level.

**2B.15.9.11.4 Automatic sprinkler locations.** Sprinkler systems shall be installed at 3.7 m intervals in horizontal ducts and at changes in direction. In vertical ducts, sprinklers shall be installed at the top and at alternate floor levels.

## **SECTION 2B.16 APPLICATION OF FLAMMABLE FINISHES**

**2B.16.1 General.** The provisions of this section shall apply to the construction, installation and use of buildings and structures, or parts thereof, for the spraying of flammable paints, varnishes and lacquers or other flammable materials or mixtures or compounds used for painting, varnishing, staining or similar purposes. Such construction and equipment shall comply with these code requirements.

**2B.16.2 Spray rooms.** Spray rooms shall be enclosed with fire barrier walls and horizontal assemblies or both with not less than a 1-hour fire-resistance rating. Floors shall be waterproofed and drained in an approved manner.

**2B.16.2.1 Surfaces.** The interior surfaces of spray rooms shall be smooth and shall be so constructed to permit the free passage of exhaust air from all parts of the interior and to facilitate washing and cleaning, and shall be so designed to confine residues within the room. Aluminum shall not be used.

**2B.16.3 Spraying spaces.** Spraying spaces shall be ventilated with an exhaust system to prevent the accumulation of flammable mist or vapors in accordance with the SBC 501. Where such spaces are not separately enclosed, noncombustible spray curtains shall be provided to restrict the spread of flammable vapors.

**2B.16.3.1 Surfaces.** The interior surfaces of spraying spaces shall be smooth and continuous without edges, and shall be so constructed to permit the free passage of exhaust air from all parts of the interior and to facilitate washing and cleaning, and shall be so designed to confine residues within the spraying space. Aluminum shall not be used.

**2B.16.4 Fire protection.** An automatic fire-extinguishing system shall be provided in all spray, dip and immersing spaces and storage rooms, and shall be installed in accordance with Chapter 7.

## **SECTION 2B.17 DRYING ROOMS**

**2B.17.1 General.** A drying room or dry kiln installed within a building shall be constructed entirely of approved noncombustible materials or assemblies of such materials regulated by the approved rules or as required in the general and specific sections of Section 2B of Chapter 2 for special occupancies and where applicable to the general requirements of SBC 501.

**2B.17.2 Piping clearance.** Overhead heating pipes shall have a clearance of not less than 51 mm from combustible contents in the dryer.

**2B.17.3 Insulation.** Where the operating temperature of the dryer is 79°C or more, metal enclosures shall be insulated from adjacent combustible materials by not less than 305 mm of airspace, or the metal walls shall be lined with 6.35 mm insulating mill

board or other approved equivalent insulation.

- 2B.17.4 Fire protection.** Drying rooms designed for high-hazard materials and processes, including special occupancies as provided for in Section 2B of Chapter 2, shall be protected by an approved automatic fire-extinguishing system conforming to the provisions of Chapter 7.

## **SECTION 2B.18 ORGANIC COATINGS**

- 2B.18.1 Building features.** Manufacturing of organic coatings shall be done only in buildings that do not have pits or basements.
- 2B.18.2 Location.** Organic coating manufacturing operations and operations incidental to or connected therewith shall not be located in buildings having other occupancies.
- 2B.18.3 Process mills.** Mills operating with close clearances and that process flammable and heat-sensitive materials, such as nitrocellulose, shall be located in a detached building or noncombustible structure.
- 2B.18.4 Tank storage.** Storage areas for flammable and combustible liquid tanks inside of structures shall be located at or above grade and shall be separated from the processing area by not less than 2 hours fire-resistance-rated fire barriers.
- 2B.18.5 Nitrocellulose storage.** Nitrocellulose storage shall be located on a detached pad or in a separate structure or a room enclosed with no less than 2 hours fire-resistance-rated fire barriers.
- 2B.18.6 Finished products.** Storage rooms for finished products that are flammable or combustible liquids shall be separated from the processing area by fire barriers having a fire-resistance rating of at least 2 hours, and openings in the walls shall be protected with approved opening protectives.

## CHAPTER 3 GENERAL BUILDING HEIGHTS AND AREAS

### SECTION 3.1 GENERAL

- 3.1.1 Scope.** The provisions of this chapter control the height and area of structures hereafter erected and additions to existing structures.
- 3.1.2 Premises identification.** Approved numbers or addresses shall be provided for new buildings in such a position as to be clearly visible and legible from the street or roadway fronting the property. Letters or numbers shall be a minimum 76 mm in height and stroke of minimum 12.7 mm of a contrasting color to the background itself.

### SECTIONS 3.2 DEFINITIONS

- 3.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**AREA, BUILDING.** The area included within surrounding exterior walls (or exterior walls and fire walls) exclusive of vent shafts and courts. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above.

**BASEMENT.** That portion of a building that is partly or completely below grade plane (See “Story above grade plane” in Chapter 1). A basement shall be considered as a story above grade plane where the finished surface of the floor above the basement is:

1. More than 1.8 m above grade plane;
2. More than 1.8 m above the finished ground level for more than 50 percent of the total building perimeter; or
3. More than 3.7 m above the finished ground level at any point.

**GRADE PLANE.** A reference plane representing the average of finished ground level adjoining the building at exterior walls. Where the finished ground level slopes away from the exterior walls, the reference plane shall be established by the lowest points within the area between the building and the lot line or, where the lot line is more than 1.8 m from the building, between the building and a point 1.8 m from the building.

**HEIGHT, BUILDING.** The vertical distance from grade plane to the average height of the highest roof surface.

**HEIGHT, STORY.** The vertical distance from top to top of two successive finished floor surfaces; and, for the topmost story, from the top of the floor finish to the top of the ceiling joists or, where there is not a ceiling, to the top of the roof rafters.

**INDUSTRIAL EQUIPMENT PLATFORM.** An unoccupied, elevated platform in an industrial occupancy used exclusively for mechanical systems or industrial process equipment, including the associated elevated walkways, stairs and ladders

necessary to access the platform (see Section 3.5.5).

**MEZZANINE.** An intermediate level or levels between the floor and ceiling of any story with an aggregate floor area of not more than one-third of the area of the room or space in which the level or levels are located (see Section 3.5).

**STORY.** That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above (also see “Basement” and “Mezzanine”).

### SECTION 3.3 GENERAL HEIGHT AND AREA LIMITATIONS

- 3.3.1 General.** The height and area for buildings of different construction types shall be governed by the intended use of the building and shall not exceed the limits in Table 3.3 except as modified hereafter. Each part of a building included within the exterior walls or the exterior walls and fire walls where provided shall be permitted to be a separate building.
- 3.3.1.1 Basements.** Basements need not be included in the total allowable area provided they do not exceed the area permitted for a one-story building.
- 3.3.1.2 Special industrial occupancies.** Buildings and structures designed to house low-hazard industrial processes that require large areas and unusual heights to accommodate crane ways or special machinery and equipment including, among others, rolling mills; structural metal fabrication shops and foundries; or the production and distribution of electric, gas or steam power, shall be exempt from the height and area limitations of Table 3.3.
- 3.3.1.3 Buildings on same lot.** Two or more buildings on the same lot shall be regulated as separate buildings or shall be considered as portions of one building if the height of each building and the aggregate area of buildings are within the limitations of Table 3.3 as modified by Sections 3.4 and 3.6. The provisions of this code applicable to the aggregate building shall be applicable to each building.
- 3.3.1.4 Type I construction.** Buildings of Type I construction permitted to be of unlimited tabular heights and areas are not subject to the special requirements that allow unlimited area buildings in Section 3.7 or unlimited height in Sections 3.3.1.2 and 3.4.3 or increased height and areas for other types of construction.
- 3.3.2 Party walls.** Any wall located on a property line between adjacent buildings, which is used or adapted for joint service between the two buildings, shall be constructed as a fire wall in accordance with Section 4B.6, without openings and shall create separate buildings.

### SECTION 3.4 HEIGHT MODIFICATIONS

- 3.4.1 General.** The heights permitted by Table 3.3 shall only be increased in accordance with this section.
- Exception:** The height of one-story aircraft hangars, aircraft paint hangars and buildings used for the manufacturing of aircraft shall not be limited if the building is provided with an automatic fire-extinguishing system in accordance with Chapter 7 and is entirely surrounded by public ways or yards not less in width than one and one-half times the height of the building.

**TABLE 3.3**  
**ALLOWABLE HEIGHT AND BUILDING AREAS**  
 Height limitations shown as stories and meters above grade plane.  
 Area limitations as determined by the definition of “Area, building,” per floor.

		TYPE OF CONSTRUCTION								
		TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
		A	B	A	B	A	B	HT	A	B
GROUP	Hgt(m)	UL	160	65	55	65	55	65	50	40
	Hgt(S)									
A-1	S	UL	5	3	2	3	2	3	2	1
	A	UL	UL	4,724	2,591	4,267	2,591	4,572	3,505	1,676
A-2	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	4,724	2,896	4,267	2,896	4,572	3,505	1,829
A-3	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	4,724	2,896	4,267	2,896	4,572	3,505	1,829
A-4	S	UL	11	3	2	3	2	3	2	1
	A	UL	UL	4,724	2,896	4,267	2,896	4,572	3,505	1,829
A-5	S	UL	UL	UL	UL	UL	UL	UL	UL	UL
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
B	S	UL	11	5	4	5	4	5	3	2
	A	UL	UL	11,430	7,010	8,687	5,791	10,973	5,486	2,743
E	S	UL	5	3	2	3	2	3	1	1
	A	UL	UL	8,077	4,420	7,163	4,420	7,772	5,639	2,896
F-1	S	UL	11	4	2	3	2	4	2	1
	A	UL	UL	7,620	4,724	5,791	3,658	10,211	4,267	2,591
F-2	S	UL	11	5	3	4	3	5	3	2
	A	UL	UL	11,278	7,010	8,687	5,486	24,536	6,401	3,962
H-1	S	1	1	1	1	1	1	1	1	NP
	A	6,401	5,029	3,353	2,134	2,896	2,134	3,200	2,286	NP
H-2	S	UL	3	2	1	2	1	2	1	1
	A	6,401	5,029	3,353	2,134	2,896	2,134	3,200	2,286	914
H-3	S	UL	6	4	2	4	2	4	2	1
	A	UL	18,288	8,077	4,267	5,334	3,962	7,772	3,048	1,524
H-4	S	UL	7	5	3	5	3	5	3	2
	A	UL	UL	11,430	5,334	8,687	5,334	10,973	5,486	1,981
H-5	S	3	3	3	3	3	3	3	3	2
	A	UL	UL	11,430	7,010	8,687	5,791	10,973	5,486	2,743
I-1	S	UL	9	4	3	4	3	4	3	2
	A	UL	16,764	5,791	3,048	5,029	3,048	5,486	3,200	1,372
I-2	S	UL	4	2	1	1	NP	1	1	NP
	A	UL	UL	4,572	3,353	3,658	NP	3,658	2,896	NP
I-3	S	UL	4	2	1	2	1	2	2	1
	A	UL	UL	4,572	3,353	3,200	2,286	3,658	2,286	1,524
I-4	S	UL	5	3	2	3	2	3	1	1
	A	UL	18,440	8,077	3,962	7,163	3,962	7,772	5,639	2,743
M	S	UL	11	4	4	4	4	4	3	1
	A	UL	UL	6,553	3,810	5,639	3,810	6,248	4,267	2,743
R-1	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	7,315	4,877	7,315	4,877	6,248	3,658	2,134
R-2 <sup>a</sup>	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	7,315	4,877	7,315	4,877	6,248	3,658	2,134
R-3 <sup>a</sup>	S	UL	11	4	4	4	4	4	3	3
	A	UL	UL	UL	UL	UL	UL	UL	UL	UL
R-4	S	UL	11	4	4	4	4	4	3	2
	A	UL	UL	7,315	4,877	7,315	4,877	6,248	3,658	2,134
S-1	S	UL	11	4	3	3	3	4	3	1
	A	UL	14,630	7,925	5,334	7,925	5,334	7,772	4,267	2,743
S-2 <sup>b-c</sup>	S	UL	11	5	4	4	4	5	4	2
	A	UL	24,079	11,887	7,925	11,887	7,925	11,735	6,401	4,115
U <sup>c</sup>	S	UL	5	4	2	3	2	4	2	1
	A	UL	10.820	5.791	2.591	4.267	2.591	5.486	2.743	1.676

UL = Unlimited, NP = Not permitted; a = As applicable in SBC 100; b.= For open parking structures, see Section 2B.6.3; and c.= For private garages, see Section 2B.6.1.

- 3.4.2 Automatic sprinkler system increase.** Where a building is equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1, the value specified in Table 3.3 for maximum height is increased by 6.1 m and the maximum number of stories is increased by one story. These increases are permitted in addition to the area increase in accordance with Sections 3.6.2 and 3.6.3. For Group R buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.2, the value specified in Table 3.3 for maximum height is increased by 6.1 m and the maximum number of stories is increased by one story, but shall not exceed four stories or 18.3 m, respectively.

**Exceptions:**

1. Group I-2 of Type IIB, III, IV or V construction.
2. Group H-1, H-2, H-3 or H-5.
3. Fire-resistance rating substitution in accordance with Table 4A.1 (FR Rated Requirements for Building Elements).

- 3.4.3 Roof structures.** Towers, spires, steeples and other roof structures shall be constructed of materials consistent with the required type of construction of the building except where other construction is permitted by Section 6.9.2.1 of SBC 201. Such structures shall not be used for habitation or storage. The structures shall be unlimited in height if of noncombustible materials and shall not extend more than 6.1 m above the allowable height if of combustible materials (see Chapter 6 of SBC 201 for additional requirements).

## SECTION 3.5 MEZZANINES

- 3.5.1 General.** A mezzanine or mezzanines in compliance with this section shall be considered a portion of the floor below. Such mezzanines shall not contribute to either the building area or number of stories as regulated by Section 3.3.1. The area of the mezzanine shall be included in determining the fire area defined in Section 4A.2. The clear height above and below the mezzanine floor construction shall not be less than 2.1 m.

- 3.5.2 Area limitation.** The aggregate area of a mezzanine or mezzanines within a room shall not exceed one-third of the area of that room or space in which they are located. The enclosed portions of rooms shall not be included in a determination of the size of the room in which the mezzanine is located. In determining the allowable mezzanine area, the area of the mezzanine shall not be included in the area of the room.

**Exception:** The aggregate area of mezzanines in buildings and structures of Type I or II construction for special industrial occupancies in accordance with Section 3.3.1.2 shall not exceed two-thirds of the area of the room.

- 3.5.3 Egress.** Each occupant of a mezzanine shall have access to at least two independent means of egress where the common path of egress travel exceeds the limitations of Section 8.4.2.5. Where a stairway provides a means of exit access from a mezzanine, the maximum travel distance includes the distance traveled on the stairway measured in the plane of the tread nosing.

**Exceptions:**

1. A single means of egress shall be permitted in accordance with Section

8.4.2.1.

2. Accessible means of egress shall be provided in accordance with Section 8.3.2.13.

**3.5.4 Openness.** A mezzanine shall be open and unobstructed to the room in which such mezzanine is located except for walls not more than 1067 mm high, columns and posts.

**Exceptions:**

1. Mezzanines or portions thereof are not required to be open to the room in which the mezzanines are located, provided that the occupant load of the aggregate area of the enclosed space does not exceed 10 add units.
2. A mezzanine having two or more means of egress is not required to be open to the room in which the mezzanine is located, if at least one of the means of egress provides direct access to an exit from the mezzanine level.
3. Mezzanines or portions thereof are not required to be open to the room in which the mezzanines are located, provided that the aggregate floor area of the enclosed space does not exceed 10 percent of the mezzanine area.
4. In industrial facilities, mezzanines used for control equipment are permitted to be glazed on all sides.
5. In Group F occupancies of unlimited area, meeting the requirements of Section 3.7.2 or 3.7.3, mezzanines or portions thereof are not required to be open to the room in which the mezzanines are located, provided that an approved fire alarm system is installed throughout the entire building or structure and notification appliances are installed throughout the mezzanines in accordance with the provisions of NFPA 72. In addition, the fire alarm system shall be initiated by automatic sprinkler water flow.

**3.5.5 Industrial equipment platforms.** Industrial equipment platforms in buildings shall not be considered as a portion of the floor below. Such equipment platforms shall not contribute to either the building area or the number of stories as regulated by Section 3.3.1. The area of the industrial equipment platform shall not be included in determining the fire area. Industrial equipment platforms shall not be a part of any mezzanine, and such platforms and the walkways, stairs and ladders providing access to an equipment platform shall not serve as a part of the means of egress from the building.

**3.5.5.1 Area limitations.** The aggregate area of all industrial equipment platforms within a room shall not exceed two-thirds of the area of the room in which they occur. Where an equipment platform is located in the same room as a mezzanine, the area of the mezzanine shall be determined by Section 3.5.2, and the combined aggregate area of the equipment platforms and mezzanines shall not exceed two-thirds of the room in which they occur.

**3.5.5.2 Fire suppression.** Where located in a building that is required to be protected by an automatic sprinkler system, industrial equipment platforms shall be fully protected by sprinklers above and below the platform, where required by the standards referenced in Section 7.3.3.

**3.5.5.3 Guards.** Equipment platforms shall have guards where required by Section 8.12.1.



## SECTION 3.6 AREA MODIFICATIONS

- 3.6.1 General.** The areas limited by Table 3.3 shall be permitted to be increased due to frontage ( $I_f$ ) and automatic sprinkler system protection ( $I_s$ ) in accordance with the following:

$$A_a = A_t + \left[ \frac{A_t I_f}{100} \right] + \left[ \frac{A_t I_s}{100} \right] \quad (\text{Equation 3-1})$$

Where:

- $A_a$  = Allowable area per floor (square meters).
- $A_t$  = Tabular area per floor in accordance with Table 3.3 (square meters).
- $I_f$  = Area increase due to frontage (percent) as calculated in accordance with Section 3.6.2.
- $I_s$  = Area increase due to sprinkler protection (percent) as calculated in accordance with Section 3.6.3.

- 3.6.1.1 Basements.** A single basement need not be included in the total allowable area provided such basement does not exceed the area permitted for a one-story building.

- 3.6.2 Frontage increase.** Every building shall adjoin or have access to a public way to receive an area increase for frontage. Where a building has more than 25 percent of its perimeter on a public way or open space having a minimum width of 6.1 m, the frontage increase shall be determined in accordance with the following:

$$I_f = 100 \left[ \frac{F}{P} - 0.25 \right] \frac{W}{30} \quad (\text{Equation 3-2})$$

Where:

- $I_f$  = Area increase due to frontage
- $F$  = Building perimeter which fronts on a public way or open space having 6.1 m open minimum width (meters)
- $P$  = Perimeter of entire building (meters)
- $W$  = Width of public way or open space (meters) in accordance with Section 3.6.2.1.

- 3.6.2.1 Width limits.**  $W$  must be at least 6.1 m and the quantity  $W$  divided by 30 shall not exceed 1.0 where the value of  $W$  varies along the perimeter of the building, the calculation performed in accordance with Equation 3-2 shall be based on the weighted average of each portion of exterior wall and open space where the value of  $W$  is between 6.1 and 9.1 m.

**Exception:** The quantity  $W$  divided by 30 shall be permitted to not exceed 2.0 when all of the following conditions exist:

1. The building is permitted to be unlimited in area by Section 3.7; and
2. The only provision preventing unlimited area is compliance with the 18.3 m public way or yard requirement, as applicable.

- 3.6.2.2 Open space limits.** Such open space shall be either on the same lot or dedicated for public use and shall be accessed from a street or approved fire lane.

- 3.6.3 Automatic sprinkler system increase.** Where a building is protected throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1, the area limitation in Table 3.3 is permitted to be increased by an additional 200 percent ( $I_s=200$  percent) for multistory buildings and an additional 300 percent ( $I_s=300$  percent) for single-story buildings. These increases are permitted in addition to the height and story increases in accordance with Section 3.4.2.

**Exceptions:**

1. Buildings with an occupancy in Group H-1, H-2 or H-3.
2. Fire-resistance rating substitution in accordance with Table 4A.1, Note d.

- 3.6.4 Area determination.** The maximum area of a building with more than one story shall be determined by multiplying the allowable area of the first floor ( $A_a$ ), as determined in Section 3.6.1, by the number of stories as listed below.

1. For two-story buildings, multiply by 2;
2. For three-story or higher buildings, multiply by 3; and
3. No story shall exceed the allowable area per floor ( $A_a$ ), as determined in Section 3.6.1 for the occupancies on that floor.

**Exceptions:**

1. Unlimited area buildings in accordance with Section 3.7.
2. The maximum area of a building equipped with an automatic sprinkler system in accordance with Section 7.3.3.1.2 shall be determined by multiplying the allowable area per floor ( $A_a$ ), as determined in Section 3.6.1 by the number of stories.

## SECTION 3.7 UNLIMITED AREA BUILDINGS

- 3.7.1 Non-sprinklered, one story.** The area of a one-story, Group F-2 or S-2 building shall not be limited when the building is surrounded and adjoined by public ways or yards not less than 18.3 m in width.

- 3.7.2 Sprinklered, one story.** The area of a one-story, Group B, F, M or S building or a one-story Group A-4 building of other than Type V construction shall not be limited when the building is provided with an automatic sprinkler system throughout in accordance with Section 7.3.3.1.1, and is surrounded and adjoined by public ways or yards not less than 18.3 m in width.

**Exceptions:**

1. Buildings and structures of Type I and II construction for rack storage facilities which do not have access by the public shall not be limited in height provided that such buildings conform to the requirements of Section 3.7.1 and NFPA 231C.
2. The automatic sprinkler system shall not be required in areas occupied for indoor participant sports, such as tennis, skating, swimming and equestrian activities, in occupancies in Group A-4, provided that:
  - 2.1 Exit doors directly to the outside are provided for occupants of the participant sports areas, and
  - 2.2 The building is equipped with a fire alarm system with manual fire alarm boxes installed in accordance with Section 7.7.

- 3.7.3 Two story.** The area of a two-story, Group B, F, M or S building shall not be limited when the building is provided with an automatic sprinkler system in accordance with Section 7.3.3.1.1 throughout, and is surrounded and adjoined by public ways or yards not less than 18.3 m in width.
- 3.7.4 Reduced open space.** The permanent open space of 18.3 m required in Sections 3.7.1, 3.7.2 and 3.7.3 shall be permitted to be reduced to not less than 12.2 m provided the following requirements are met:
1. The reduced open space shall not be allowed for more than 75 percent of the perimeter of the building.
  2. The exterior wall facing the reduced open space shall have a minimum fire-resistance rating of 3 hours.
  3. Openings in the exterior wall, facing the reduced open space, shall have opening protectives with a fire-resistance rating of 3 hours.
- 3.7.5 Group A-3 buildings.** The area of a one-story, Group A-3 building used as a prayer hall, community hall, exhibition hall, gymnasium, lecture hall, indoor swimming pool or tennis court of Type I or II construction shall not be limited when all of the following criteria are met:
1. The building shall not have a stage other than a platform.
  2. The building shall be equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
  3. The assembly floor shall be located at or within 533 mm of street or grade level and all exits are provided with ramps complying with Section 8.10.1 to the street or grade level.
  4. The building shall be surrounded and adjoined by public ways or yards not less than 18.3 m in width.
- 3.7.6 High-hazard use groups.** Group H-2, H-3 and H-4 fire areas shall be permitted in unlimited area buildings having occupancies in Groups F and S, in accordance with the limitations of this section. Fire areas located at the perimeter of the unlimited area building shall not exceed 10 percent of the area of the building nor the area limitations specified in Table 3.3 as modified by Section 3.6.2, based upon the percentage of the perimeter of the fire area that fronts on a street or other unoccupied space. Other fire areas shall not exceed 25 percent of the area limitations specified in Table 3.3. Fire-resistance-rating requirements of fire barrier assemblies shall be in accordance with Table 2A.2.3.3.
- 3.7.7 Aircraft paint hangar.** The area of a one-story, Group H-2 aircraft paint hangar shall not be limited where such aircraft paint hangar complies with the provisions of Section 2B.12.4 and is entirely surrounded by public ways or yards not less in width than one and one-half times the height of the building.
- 3.7.8 Group E buildings.** The area of a one-story Group E building of Type II, IIIA or IV construction shall not be limited when the following criteria are met:
1. Each classroom shall have not less than two means of egress, with one of the means of egress being a direct exit to the outside of the building complying with Section 8.17.
  2. The building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

3. The building is surrounded and adjoined by public ways or yards not less than 18.3 m in width.

- 3.7.9 **Motion picture theaters.** In buildings of Type I or II construction, the area of one-story motion picture theaters shall not be limited when the building is provided with an automatic sprinkler system throughout in accordance with Section 7.3.3.1.1 and is surrounded and adjoined by public ways or yards not less than 18.3 m in width.

### SECTION 3.8 SPECIAL PROVISIONS

- 3.8.1 **General.** The provisions in this section shall permit the use of special conditions that are exempt from, or modify, the specific requirements of this chapter regarding the allowable heights and areas of buildings based on the occupancy classification and type of construction, provided the special condition complies with the provisions specified in this section for such condition and other applicable requirements of this code.

- 3.8.2 **Group S-2 enclosed parking garage with Group A, B, M or R above.** A basement and/or the first story above grade plane of a building shall be considered as a separate and distinct building for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories and type of construction, when all of the following conditions are met:

1. The basement and/or the first story above grade plane is of Type IA construction and is separated from the building above with a horizontal assembly having a minimum 3 hours fire-resistance rating.
2. Shaft, stairway, ramp or escalator enclosures through the horizontal assembly shall have not less than a 2-hour fire-resistance rating with opening protectives in accordance with Table 4B.16.3.

**Exception:** Where the enclosure walls below the horizontal assembly have not less than a 3 hours fire-resistance rating with opening protectives in accordance with Table 4B.16.3 (Fire Door & Fire Shutter Fire Protection Ratings), the enclosure walls extending above the horizontal assembly shall be permitted to have a 1-hour fire-resistance rating provided:

1. The building above the horizontal assembly is not required to be of Type I construction;
2. The enclosure connects less than four stories, and
3. The enclosure opening protectives above the horizontal assembly have a minimum 1-hour fire protection rating.
3. The building above the horizontal assembly contains only Group A having an assembly room with an occupant load of less than 300, or Group B, M or R; and
4. The building below the horizontal assembly is a Group S-2 enclosed parking garage, used for the parking and storage of private motor vehicles.

**Exceptions:**

1. Entry lobbies, mechanical rooms and similar uses incidental to the operation of the building shall be permitted.
2. Group A having an assembly room with an occupant load of less than 300, or Group B or M shall be permitted in addition to those uses incidental to

the operation of the building (including storage areas), provided that the entire structure below the horizontal assembly is protected throughout by an approved automatic sprinkler system.

5. The maximum building height in feet shall not exceed the limits set forth in Table 3.3 for the least restrictive type of construction involved.

**3.8.3 Group S-2 enclosed parking garage with Group S-2 open parking garage above.** A Group S-2 enclosed parking garage located in the basement or first story below a Group S-2 open parking garage shall be classified as a separate and distinct building for the purpose of determining the type of construction when the following conditions are met:

1. The allowable area of the structure shall be such that the sum of the ratios of the actual area divided by the allowable area for each separate occupancy shall not exceed 1.0.
2. The Group S-2 enclosed parking garage is of Type I or II construction and is at least equal to the fire-resistance requirements of the Group S-2 open parking garage.
3. The height and the number of the floors above the basement shall be limited as specified in Table 2B.6.3.5 (Open Parking Garages Area & Height).
4. The floor assembly separating the Group S-2 enclosed parking garage and Group S-2 open parking garage shall be protected as required for the floor assembly of the Group S-2 enclosed parking garage. Openings between the Group S-2 enclosed parking garage and Group S-2 open parking garage, except exit openings, shall not be required to be protected.
5. The Group S-2 enclosed parking garage is used exclusively for the parking or storage of private motor vehicles, but shall be permitted to contain an office, waiting room and toilet room having a total area of not more than 93 m<sup>2</sup>, and mechanical equipment rooms incidental to the operation of the building.

**3.8.4 Parking beneath Group R.** Where a maximum one-story above grade plane Group S-2 parking garage, enclosed or open, or combination thereof, of Type I construction or open of Type IV construction, with grade entrance, is provided under a building of Group R, the number of stories to be used in determining the minimum type of construction shall be measured from the floor above such a parking area. The floor assembly between the parking garage and the Group R above shall comply with the type of construction required for the parking garage and shall also provide a fire-resistance rating not less than the mixed occupancy separation required in Section 2A.2.3.3.

**3.8.5 Group R-2 buildings of Type IIIA construction.** The height limitation for buildings of Type IIIA construction in Group R-2 shall be increased to six stories and 23 m where the first-floor construction above the basement has a fire-resistance rating of not less than 3 hours and the floor area is subdivided by 2-hour fire-resistance-rated fire walls into areas of not more than 279 m<sup>2</sup>.

**3.8.6 Group R-2 buildings of Type IIA construction.** The height limitation for buildings of Type IIA construction in Group R-2 shall be increased to nine stories and 30.5 m where the building is separated by not less than 15.3 m from any other building on the lot and from property lines, the exits are segregated in an area enclosed by a 2-hour fire-resistance-rated fire wall and the first-floor construction

has a fire-resistance rating of not less than 1<sup>1</sup>/<sub>2</sub> hours.

- 3.8.7 Open parking garage beneath Groups A, I, B, M and R.** Open parking garages constructed under Groups A, I, B, M and R shall not exceed the height and area limitations permitted under Section 2B.6.3. The height and area of the portion of the building above the open parking garage shall not exceed the limitations in Section 3.3 for the upper occupancy. The height, in both feet and stories, of the portion of the building above the open parking garage shall be measured from grade plane and shall include both the open parking garage and the portion of the building above the parking garage.
- 3.8.7.1 Fire separation.** Fire separation assemblies between the parking occupancy and the upper occupancy shall correspond to the required fire-resistance rating prescribed in Table 2A.2.3.3 for the uses involved. The type of construction shall apply to each occupancy individually, except that structural members, including main bracing within the open parking structure, which is necessary to support the upper occupancy, shall be protected with the more restrictive fire-resistance-rated assemblies of the groups involved as shown in Table 4A.1. Means of egress for the upper occupancy shall conform to Chapter 8 and shall be separated from the parking occupancy by fire barriers having at least a 2-hour fire-resistance rating as required by Section 4B.7, with self-closing doors complying with Section 4B.16. Means of egress from the open parking garage shall comply with Section 2B.6.3.



## CHAPTER 4 TYPES OF CONSTRUCTION AND FIRE-RESISTANCE-RATED CONSTRUCTION

### SECTION 4A TYPES OF CONSTRUCTION

#### SECTION 4A.1 GENERAL

- 4A.1.1 Scope.** The provisions of this chapter shall control the classification of buildings as to type of construction.

#### SECTION 4A.2 CONSTRUCTION CLASSIFICATION

- 4A.2.1 General.** Buildings and structures erected or to be erected, altered or extended in height or area shall be classified in one of the five construction types defined in Sections 4A.2.2 through 4A.2.5. The building elements shall have a fire-resistance rating not less than that specified in Table 4A.1 and exterior walls shall have a fire-resistance rating not less than that specified in Table 4A.2.
- 4A.2.1.1 Minimum requirements.** A building or portion thereof shall not be required to conform to the details of a type of construction higher than that type, which meets the minimum requirements based on occupancy even though certain features of such a building actually conform to a higher type of construction.
- 4A.2.2 Types I and II.** Type I and II construction are those types of construction in which the building elements listed in Table 4A.1 are of noncombustible materials.
- 4A.2.3 Type III.** Type III construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by these code requirements. Fire-retardant-treated wood framing shall be permitted within exterior wall assemblies of a 2-hour rating or less.
- 4A.2.4 Type IV.** Type IV construction (Heavy Timber, HT) is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid or laminated wood without concealed spaces. The details of Type IV construction shall comply with the provisions of this section. Fire-retardant-treated wood framing shall be permitted within exterior wall assemblies with a 2-hour rating or less.
- 4A.2.4.1 Columns.** Wood columns shall be sawn or glued laminated and shall not be less than 200 mm, nominal, in any dimension where supporting floor loads and not less than 150 mm nominal in width and not less than 200 mm nominal in depth where supporting roof and ceiling loads only. Columns shall be continuous or superimposed and connected in an approved manner.
- 4A.2.4.2 Floor framing.** Wood beams and girders shall be of sawn or glued-laminated timber and shall be not less than 150 mm nominal in width and not less than 250 mm nominal in depth. Framed sawn or glued-laminated timber arches, which spring from the floor line and support floor loads, shall be not less than 200 mm nominal in any dimension. Framed timber trusses supporting floor loads shall have members of not less than 200 mm nominal in any dimension.



- 4A.2.4.3 Roof framing.** Wood-frame or glued-laminated arches for roof construction, which spring from the floor line or from grade and do not support floor loads, shall have members not less than 150 mm nominal in width and have less than 200 mm nominal in depth for the lower half of the height and not less than 150 mm nominal in depth for the upper half. Framed or glued laminated arches for roof construction that spring from the top of walls or wall abutments, framed timber trusses and other roof framing, which do not support floor loads, shall have members not less than 100 mm nominal in width and not less than 150 mm nominal in depth. Spaced members shall be permitted to be composed of two or more pieces not less than 76 mm nominal in thickness where blocked solidly throughout their intervening spaces or where spaces are tightly closed by a continuous wood cover plate of not less than 51 mm nominal in thickness secured to the underside of the members. Splice plates shall be not less than 76 mm nominal in thickness. Where protected by approved automatic sprinklers under the roof deck, framing members shall be not less than 76 mm nominal in width.
- 4A.2.4.4 Floors.** Floors shall be without concealed spaces. Wood floors shall be of sawn or glued-laminated planks, splined or tongue-and-groove, of not less than 76 mm nominal in thickness covered with 25 mm nominal dimension tongue-and-groove flooring, laid crosswise or diagonally, or 13 mm particleboard or planks not less than 100 mm nominal in width set on edge close together and well spiked and covered with 25 mm nominal dimension flooring or 12 mm wood structural panel or 13 mm particleboard. The lumber shall be laid so that no continuous line of joints will occur except at points of support. Floors shall not extend closer than 13 mm to walls. Such 13 mm space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinkage movements of the floor. Corbeling of masonry walls under the floor shall be permitted to be used in place of molding.
- 4A.2.4.5 Roofs.** Roofs shall be without concealed spaces and wood roof decks shall be sawn or glued laminated, splined or tongue-and-groove plank, not less than 51 mm thick, 32 mm wood structural panel (exterior glue), or of planks not less than 76 mm nominal in width, set on edge close together and laid as required for floors. Other types of decking shall be permitted to be used if providing equivalent fire resistance and structural properties.
- 4A.2.4.6 Partitions.** Partitions shall be of solid wood construction formed by not less than two layers of 25 mm matched boards or laminated construction 100 mm thick, or of 1-hour fire-resistance-rated construction.
- 4A.2.4.7 Exterior structural members.** Where a horizontal separation of 6.1 m or more is provided, wood columns and arches conforming to heavy timber sizes shall be permitted to be used externally.
- 4A.2.5 Type V.** Type V construction is that type of construction in which the structural elements, exterior walls and interior walls are of any materials permitted by these code requirements.

### SECTION 4A.3 COMBUSTIBLE MATERIALS IN TYPES I AND II CONSTRUCTION

- 4A.3.1 Allowable materials.** Combustible materials shall be permitted in buildings of Type I or II construction in the following applications and in accordance with Sections 4A.3.1.1 through 4A.3.1.3:
- 1.** Fire-retardant-treated wood shall be permitted in:

- 1.1. Nonbearing partitions where the required fire-resistance rating is 2 hours or less.
- 1.2. Nonbearing exterior walls where no fire rating is required.
- 1.3. Roof construction as permitted in Table 4A.1, Note c, Item 3.
2. Thermal and acoustical insulation, other than foam plastics, having a flame spread index of not more than 25.  
**Exceptions:**
  1. Insulation placed between two layers of noncombustible materials without an intervening airspace shall be allowed to have a flame spread index of not more than 100.
  2. Insulation installed between a finished floor and solid decking without intervening airspace shall be allowed to have a flame spread index of not more than 200.
3. Foam plastics in accordance with Chapter 11 of the SBC 201.
4. Roof coverings that have an A, B or C classification.
5. Interior floor finish and interior finish, trim and millwork such as doors, door frames, window sashes and frames.
6. Where not installed over 4.6 m above grade, show windows, nailing or furring strips, wooden bulkheads below show windows, their frames, aprons and show cases.
7. Finished flooring applied directly to the floor slab or to wood sleepers that are firestopped in accordance with Section 4B.17.2.7.
8. Partitions dividing portions of stores, offices or similar places occupied by one tenant only and which do not establish a corridor serving an occupant load of 30 or more shall be permitted to be constructed of fire-retardant-treated wood, 1-hour fire-resistance-rated construction or of wood panels or similar light construction up to 1.83 m in height.
9. Platforms as permitted in Section 2B.10.
10. Combustible exterior wall coverings, balconies, bay or oriel windows, or similar appendages in accordance with Chapter 5 of the SBC 201.
11. Blocking such as for handrails, millwork, cabinets, and window and door frames.
12. Light-transmitting plastics as permitted by Chapter 11 of the SBC 201.
13. Mastics and caulking materials applied to provide flexible seals between components of exterior wall construction.
14. Exterior plastic veneer installed in accordance with Section 11.5.2 of the SBC 201.
15. Nailing or furring strips as permitted by Section 6.3.3.
16. Heavy timber as permitted by Note c, Item 2, to Table 4A.1 and Sections 4A.2.4.7 and 5.6.3 of the SBC 201.
17. Aggregates, component materials and admixtures as permitted by Section 4B.3.2.2.
18. Sprayed cementitious and mineral fiber fire-resistance-rated materials installed to comply with SBC 302.
19. Materials used to protect penetrations in fire-resistance-rated assemblies in accordance with Section 4B.12.
20. Materials used to protect joints in fire-resistance-rated assemblies in accordance with Section 4B.13.
21. Materials allowed in the concealed spaces of buildings of Type I and II construction in accordance with Section 4B.17.5.
22. Materials exposed within plenums complying with SBC 501.

- 4A.3.1.1 Ducts.** The use of nonmetallic ducts shall be permitted when installed in accordance with the limitations of the SBC 501.
- 4A.3.1.2 Piping.** The use of combustible piping materials shall be permitted when installed in accordance with the limitations of the SBC 501 and the SBC 501.
- 4A.3.1.3 Electrical.** The use of electrical wiring methods with combustible insulation, tubing, raceways and related components shall be permitted when installed in accordance with the limitations of the SBC 501.

**TABLE 4A.1  
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)**

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A <sup>d</sup>	B	A <sup>d</sup>	B	HT	A <sup>d</sup>	B
Structural frame <sup>a</sup> Including columns, girders, trusses	3 <sup>b</sup>	2 <sup>b</sup>	1	0	1	0	HT	1	0
Bearing walls Exterior <sup>f</sup> Interior	3 3 <sup>b</sup>	2 2 <sup>b</sup>	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior									
Nonbearing walls and partitions Interior <sup>e</sup>	0	0	0	0	0	0	See Section 4A.2.4.6	0	0
Floor construction Including supporting beams and joists	2	2	1	0	1	0	HT	1	0
Roof construction Including supporting beams and joists	1 1/2 <sup>c</sup>	1 <sup>c</sup>	1 <sup>c</sup>	0	1 <sup>c</sup>	0	HT	1 <sup>c</sup>	0

- a. The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and bracing members designed to carry gravity loads. The members of floor or roof panels which have no connection to the columns shall be considered secondary members and not a part of the structural frame.
- b. Roof supports: Fire-resistance ratings of structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
- c.
  1. Except in Factory-Industrial (F-1), Hazardous (H), Mercantile (M) and Moderate-Hazard Storage (S-1) occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 6.1 m or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
  2. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.
  3. In Type I and II construction, fire-retardant-treated wood shall be allowed in buildings including girders and trusses as part of the roof construction when the building is:
    - i. Two stories or less in height;
    - ii. Type II construction over two stories; or
    - iii. Type I construction over two stories and the vertical distance from the upper floor to the roof is 6.1 m or more.
- d. An approved automatic sprinkler system in accordance with Section 7.3.3.1.1 shall be allowed to be substituted for 1-hour fire-resistance-rated construction, provided such system is not otherwise required by other provisions of the code or used for an allowable area increase in accordance with Section 3.6.3 or an allowable height increase in accordance with Section 3.4.2. The 1-hour substitution for the fire resistance of exterior walls shall not be permitted.
- e. Not less than the fire-resistance rating required by other sections of these code requirements.
- f. Not less than the fire-resistance rating based on fire separation distance (see Table 4A.2).

**TABLE 4A.2**  
**FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE<sup>a</sup>**

<b>FIRE SEPARATION DISTANCE (meters)</b>	<b>TYPE OF CONSTRUCTION</b>	<b>GROUP H</b>	<b>GROUP F-1, M, S-1</b>	<b>GROUP A, B, E, F-2, I, R<sup>b</sup>, S-2, U</b>
< 1.5 <sup>c</sup>	All	3	2	1
≥ 1.5	IA	3	2	1
< 3.1	Others	2	1	1
≥ 3.1	IA, IB	2	1	1
< 9.1	IIB, VB	1	0	0
	Others	1	1	1
≥ 9.1	All	0	0	0

- a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 4A.1.
- b. Group R-3 and Group U when used as accessory to Group R-3, as applicable in SBC 100 shall not be required to have a fire-resistance rating where the fire separation distance is 0.9 m or more.
- c. See Section 3.3.2 for party walls.

## **SECTION 4B** **FIRE-RESISTANCE-RATED CONSTRUCTION**

### **SECTION 4B.1** **GENERAL**

- 4B.1.1 Scope.** The provisions of this chapter shall govern the materials and assemblies used for structural fire resistance and fire-resistance-rated construction separation of adjacent spaces to safeguard against the spread of fire and smoke within a building and the spread of fire to or from buildings.

### **SECTION 4B.2** **DEFINITIONS**

- 4B.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter, and as used elsewhere in these code requirements, have the meanings shown herein.

**ANNULAR SPACE.** The opening around the penetrating item.

**CEILING RADIATION DAMPER.** A listed device installed in a ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly to limit automatically the radiative heat transfer through an air inlet/outlet opening.

**COMBINATION FIRE/SMOKE DAMPER.** A listed device installed in ducts and air transfer openings designed to close automatically upon the detection of heat and to also resist the passage of air and smoke. The device is installed to operate automatically, controlled by a smoke detection system, and where required, is capable of being positioned from a remote command station.

**DAMPER.** See “Ceiling radiation damper,” “Combination fire/smoke damper,” “Fire damper” and “Smoke damper.”

**DRAFT STOP.** A material, device or construction installed to restrict the movement of air within open spaces of concealed areas of building components such as crawl spaces, floor/ceiling assemblies, roof/ceiling assemblies and attics.

**F RATING.** The time period that the through-penetration firestop system limits the spread of fire through the penetration when tested in accordance with ASTM E 814.

**FIRE AREA.** The aggregate floor area enclosed and bounded by firewalls, fire barriers, exterior walls or fire-resistance-rated horizontal assemblies of a building.

**FIRE BARRIER.** A fire-resistance-rated vertical or horizontal assembly of materials designed to restrict the spread of fire in which openings are protected.

**FIRE DAMPER.** A listed device, installed in ducts and air transfer openings of an air distribution system or smoke control systems, designed to close automatically upon detection of heat, to interrupt migratory airflow, and to restrict the passage of flame. Fire dampers are classified for use in either static systems that will automatically shutdown in the event of a fire, or in a dynamic system that continues to operate during a fire. A dynamic fire damper is tested and rated for closure under airflow.

**FIRE DOOR.** The door component of a fire door assembly.

**FIRE DOOR ASSEMBLY.** Any combination of a fire door, frame, hardware, and other accessories that together provide a specific degree of fire protection to the opening.

**FIRE PARTITION.** A vertical assembly of materials designed to restrict the spread of fire in which openings are protected.

**FIRE PROTECTION RATING.** The period of time that an opening protective assembly will maintain the ability to confine a fire as determined by tests prescribed in Section 4B.15. Ratings are stated in hours or minutes.

**FIRE RESISTANCE.** That property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.

**FIRE-RESISTANCE RATING.** The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on tests, prescribed in Section 4B.3.

**FIRE-RESISTANT JOINT SYSTEM.** An assemblage of specific materials or products that are designed, tested, and fire-resistance rated in accordance with either ASTM E 1966 or UL 2079 to resist for a prescribed period of time the passage of fire through joints made in or between fire-resistance-rated assemblies.

**FIRE SEPARATION DISTANCE.** The distance measured from the building face to the closest interior lot line, to the centerline of a street, alley or public way,

or to an imaginary line between two buildings on the lot. The distance shall be measured at right angles from the face of the wall.

**FIRE WALL.** A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.

**FIRE WINDOW ASSEMBLY.** A window constructed and glazed to give protection against the passage of fire.

**FIREBLOCKING.** Building materials installed to resist the free passage of flame to other areas of the building through concealed spaces.

**FLOOR FIRE DOOR ASSEMBLY.** A combination of a fire door, a frame, hardware and other accessories installed in a horizontal plane, which together provide a specific degree of fire protection to a through opening in a fire-resistance-rated floor (see Section 4B.12.4.6).

**JOINT.** The linear opening in or between adjacent fire-resistance-rated assemblies that is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.

**MEMBRANE PENETRATION.** An opening made through one side (wall, floor or ceiling membrane) of an assembly.

**MEMBRANE-PENETRATION FIRESTOP.** A material, device or construction installed to resist for a prescribed time period the passage of flame and heat through openings in a protective membrane in order to accommodate cables, cable trays, conduit, tubing, pipes or similar items.

**PENETRATION FIRESTOP.** A through-penetration fire stop or a membrane-penetration fire stop.

**SELF-CLOSING.** As applied to a fire door or other opening, means equipped with an approved device that will ensure closing after having been opened.

**SHAFT.** An enclosed space extending through one or more stories of a building, connecting vertical openings in successive floors, or floors and roof.

**SHAFT ENCLOSURE.** The walls or construction forming the boundaries of a shaft.

**SMOKE BARRIER.** A continuous membrane, either vertical or horizontal, such as a wall, floor, or ceiling assembly, that is designed and constructed to restrict the movement of smoke.

**SMOKE COMPARTMENT.** A space within a building enclosed by smoke barriers on all sides, including the top and bottom.

**SMOKE DAMPER.** A listed device installed in ducts and air transfer openings that is designed to resist the passage of air and smoke. The device is installed to

operate automatically, controlled by a smoke detection system, and where required, is capable of being positioned from a remote command station.

**SPLICE.** The result of a factory and/or field method of joining or connecting two or more lengths of a fire-resistant joint system into a continuous entity.

**T RATING.** The time period that the penetration fire stop system, including the penetrating item, limits the maximum temperature rise to 163°C above its initial temperature through the penetration on the non-fire side when tested in accordance with ASTM E 814.

**THROUGH PENETRATION.** An opening that passes through an entire assembly.

**THROUGH-PENETRATION FIRE STOP SYSTEM.** An assemblage of specific materials or products that are designed, tested and fire-resistance rated to resist for a prescribed period of time the spread of fire through penetrations. The F and T rating criteria for penetration fire stop systems shall be in accordance with ASTM E 814. See definitions of “F rating” and “T rating.”

### **SECTION 4B.3 FIRE-RESISTANCE RATINGS AND FIRE TESTS**

**4B.3.1 Scope.** Materials prescribed herein for fire resistance shall conform to the requirements of this chapter.

**4B.3.2 Fire-resistance ratings.** The fire-resistance rating of building elements shall be determined in accordance with the test procedures set forth in ASTM E 119 or in accordance with Section 4B.3.3. Where materials, systems or devices that have not been tested as part of a fire-resistance-rated assembly are incorporated into the assembly, sufficient data shall be made available to the building official to show that the required fire-resistance rating is not reduced. Materials and methods of construction used to protect joints and penetrations in fire-resistance-rated building elements shall not reduce the required fire-resistance rating.

**Exception:** In determining the fire-resistance rating of exterior bearing walls, compliance with the ASTM E 119 criteria for unexposed surface temperature rise and ignition of cotton waste due to passage of flame or gases is required only for a period of time corresponding to the required fire-resistance rating of an exterior nonbearing wall with the same fire separation distance, and in a building of the same group. When the fire-resistance rating determined in accordance with this exception exceeds the fire-resistance rating determined in accordance with ASTM E 119, the fire exposure time period, water pressure, and application duration criteria for the hose stream test of ASTM E 119 shall be based upon the fire-resistance rating determined in accordance with this exception.

**4B.3.2.1 Nonsymmetrical wall construction.** Interior walls and partitions of nonsymmetrical construction shall be tested with both faces exposed to the furnace, and the assigned fire-resistance rating shall be the shortest duration obtained from the two tests conducted in compliance with ASTM E 119. When evidence is furnished to show that the wall was tested with the least fire-resistant side exposed to the furnace, subject to acceptance of the building official, the wall need not be subjected to tests from the opposite side (see Section 4B.4.5 for exterior walls).

- 4B.3.2.2 Combustible components.** Combustible aggregates are permitted in gypsum and Portland cement concrete mixtures approved for fire-resistance-rated construction. Any approved component material or admixture is permitted in assemblies if the resulting tested assembly meets the fire-resistance test requirements of these code requirements.
- 4B.3.2.3 Restrained classification.** Fire-resistance-rated assemblies tested under ASTM E 119 shall not be considered to be restrained unless evidence satisfactory to the building official is furnished by the registered design professional showing that the construction qualifies for a restrained classification in accordance with ASTM E 119. Restrained construction shall be identified on the plans.
- 4B.3.3 Alternative methods for determining fire resistance.** The application of any of the alternative methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E 119. The required fire resistance of a building element shall be permitted to be established by any of the following methods or procedures:
1. Fire-resistance designs documented in approved sources.
  2. Prescriptive designs of fire-resistance-rated building elements as prescribed in Section 4B.20.
  3. Calculations in accordance with Section 4B.21.
  4. Engineering analysis based on a comparison of building element designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E 119.
  5. Alternative protection methods as allowed by a building official.
- 4B.3.4 Noncombustibility tests.** The tests indicated in Sections 4B.3.4.1 and 4B.3.4.2 shall serve as criteria for acceptance of building materials as set forth in Sections 4A.2.2, 4A.2.3 and 4A.2.4 in Type I, II, III and IV construction. The term “noncombustible” does not apply to the flame spread characteristics of interior finish or trim materials. A material shall not be classified as a noncombustible building construction material if it is subject to an increase in combustibility or flame spread beyond the limitations herein established through the effects of age, moisture or other atmospheric conditions.
- 4B.3.4.1 Elementary materials.** Materials required to be noncombustible shall be tested in accordance with ASTM E 136.
- 4B.3.4.2 Composite materials.** Materials having a structural base of noncombustible material as determined in accordance with Section 4B.3.4.1 with a surfacing not more than 3 mm thick that has a flame spread index not greater than 50 when tested in accordance with ASTM E 84 shall be acceptable as noncombustible materials.

## SECTION 4B.4 EXTERIOR WALLS

- 4B.4.1 General.** Exterior walls shall be fire-resistance rated and have opening protection as required by this section.
- 4B.4.2 Projections.** Cornices, eave overhangs, exterior balconies and similar architectural appendages extending beyond the floor area shall conform to the requirements of this section and Section 5.6 of the SBC 201. Exterior egress balconies and exterior exit stairways shall also comply with Sections 8.13.5 and 8.22.1. Projections shall not extend beyond the distance determined by the following two methods, whichever results in the lesser projection:



1. A point one-third the distance to the lot line from an assumed vertical plane located where protected openings are required in accordance with Section 4B.4.8.
2. More than 300 mm into areas where openings are prohibited.

**4B.4.2.1 Type I and II construction.** Projections from walls of Type I or II construction shall be of noncombustible materials or combustible materials as allowed by Sections 5.6.3 and 5.6.4 of the SBC 201.

**4B.4.2.2 Type III, IV or V construction.** Projections from walls of Type III, IV or V construction shall be of any approved material.

**4B.4.2.3 Combustible projections.** Combustible projections located where openings are not permitted or where protection of openings is required shall be of at least 1-hour fire-resistance-rated construction, Type IV construction or as required by Section 5.6.3 of the SBC 201.

**Exception:** Type V construction shall be allowed for R-3 occupancies, as applicable in SBC 201.

**4B.4.3 Buildings on the same lot.** For the purposes of determining the required wall and opening protection and roof-covering requirements, buildings on the same lot shall be assumed to have an imaginary line between them. Where a new building is to be erected on the same lot as an existing building, the location of the assumed imaginary line with relation to the existing building shall be such that the exterior wall and opening protection of the existing building meet the criteria as set forth in Sections 4B.4.5 and 4B.4.8.

**Exception:** Two or more buildings on the same lot shall either be regulated as separate buildings or shall be considered as portions of one building if the aggregate area of such buildings is within the limits specified in Chapter 3 for a single building. Where the buildings contain different occupancy groups or are of different types of construction, the area shall be that allowed for the most restrictive occupancy or construction.

**4B.4.4 Materials.** Exterior walls shall be of materials permitted by the building type of construction.

**4B.4.5 Fire-resistance ratings.** Exterior walls shall be fire-resistance rated in accordance with Tables 4A.1 and 4A.2. The fire-resistance rating of exterior walls with a fire separation distance of greater than 1.52 m shall be rated for exposure to fire from the inside. The fire-resistance rating of exterior walls with a fire separation distance of 1.52 m or less shall be rated for exposure to fire from both sides.

**4B.4.6 Structural stability.** The wall shall extend to the height required by Section 4B.4.11 and shall have sufficient structural stability such that it will remain in place for the duration of time indicated by the required fire-resistance rating.

**4B.4.7 Unexposed surface temperature.** Where protected openings are not limited by Section 4B.4.8, the limitation on the rise of temperature on the unexposed surface of exterior walls as required by ASTM E 119 shall not apply. Where protected openings are limited by Section 4B.4.8, the limitation on the rise of temperature on the unexposed surface of exterior walls as required by ASTM E 119 shall not apply provided that a correction is made for radiation from the unexposed exterior wall surface in accordance with the following formula:

$$A_e = A + (A_f \times F_{eo}) \quad \text{(Equation 4B.-1)}$$

Where:

- $A_e$  = Equivalent area of protected openings.  
 $A$  = Actual area of protected openings.  
 $A_f$  = Area of exterior wall surface in the story under consideration exclusive of openings, on which the temperature limitations of ASTM E 119 for walls are exceeded.  
 $F_{eo}$  = An “equivalent opening factor” derived from Figure 4B.4.7 based on the average temperature of the unexposed wall surface and the fire-resistance rating of the wall.

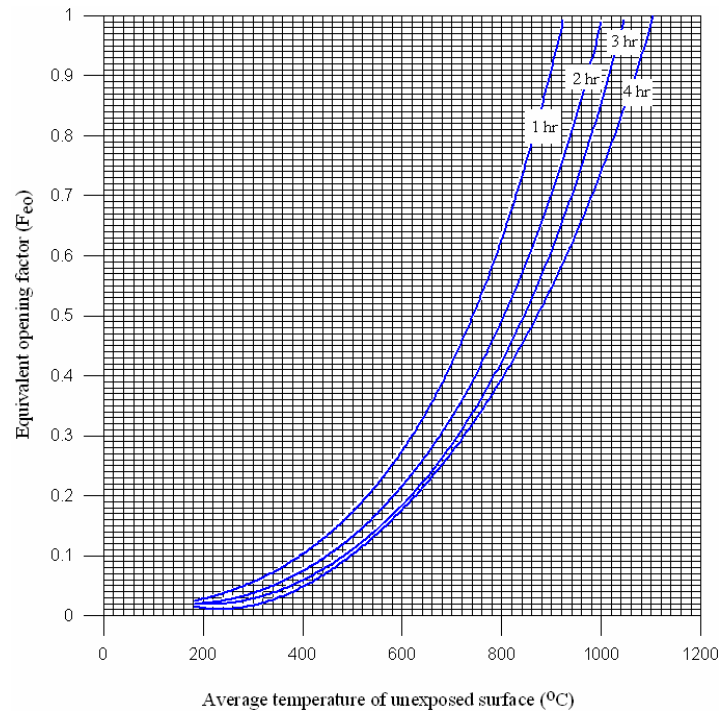


FIGURE 4B.4.7 EQUIVALENT OPENING FACTOR

**4B.4.8 Allowable area of openings.** The maximum area of unprotected or protected openings permitted in an exterior wall in any story shall not exceed the values set forth in Table 4B.4.8. Where both unprotected and protected openings are located in the exterior wall in any story, the total area of the openings shall comply with the following formula:

$$\frac{A}{a} + \frac{A_u}{a_u} \leq 1.0 \quad \text{(Equation 4B.-2)}$$

Where:

- $A$  = Actual area of protected openings, or the equivalent area of protected openings,  $A_e$  (see Section 4B.4.7).  
 $a$  = Allowable area of protected openings.  
 $A_u$  = Actual area of unprotected openings.  
 $a_u$  = Allowable area of unprotected openings.

**TABLE 4B.4.8**  
**MAXIMUM AREA OF EXTERIOR WALL OPENINGS<sup>a</sup>**

CLASSIFICATION OF OPENING	FIRE SEPARATION DISTANCE (meters)							
	0 to 1 <sup>c,h</sup>	Greater than 1 to 1.5 <sup>b</sup>	Greater than 1.5 to 3 <sup>d,f</sup>	Greater than 3 to 4.5 <sup>c,d,f</sup>	Greater than 4.5 to 6 <sup>c,f</sup>	Greater than 6 to 7.5 <sup>c,f</sup>	Greater than 7.5 to 9 <sup>c,f</sup>	Greater than 9
Unprotected	Not Permitted <sup>g</sup>	Not Permitted <sup>b,g</sup>	10% <sup>g</sup>	15% <sup>g</sup>	25% <sup>g</sup>	45% <sup>g</sup>	70% <sup>g</sup>	No Limit
Protected	Not Permitted	15%	25%	45%	75%	No Limit	No Limit	No Limit

- Values given are percentage of the area of the exterior wall.
- For occupancies in Group R-3, as applicable in SBC 201, the maximum percentage of unprotected and protected exterior wall openings shall be 25 percent.
- The area of openings in an open parking structure with a fire separation distance of greater than 3 m shall not be limited.
- For occupancies in Group H-2 or H-3, unprotected openings shall not be permitted for openings with a fire separation distance of 4.5m or less.
- For requirements for fire walls for buildings with differing roof heights, see Section 4B.5.6.1.
- The area of unprotected and protected openings is not limited for occupancies in Group R-3, as applicable in SBC 201, with a fire separation distance greater than 1.5m.
- Buildings whose exterior bearing wall, exterior nonbearing wall and exterior structural frame are not required to be fire-resistance-rated shall be permitted to have unlimited unprotected openings.
- Includes accessory buildings to Group R-3 as applicable in SBC 201.

**4B.4.8.1 Automatic sprinkler system.** In buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, the maximum allowable area of unprotected openings in occupancies other than Groups H-1, H-2 and H-3 shall be the same as the tabulated limitations for protected openings.

**4B.4.8.2 First story.** In occupancies other than Group H, unlimited unprotected openings are permitted in the first story of exterior walls facing a street that have a fire separation distance of greater than 4.5 m, or facing an unoccupied space. The unoccupied space shall be on the same lot or dedicated for public use, shall not be less than 9 m in width, and shall have access from a street by a posted fire lane in accordance with these code requirements.

**4B.4.9 Vertical separation of openings.** Openings in exterior walls in adjacent stories shall be separated vertically to protect against fire spread on the exterior of the buildings where the openings are within 1.5 m of each other horizontally and the opening in the lower story is not a protected opening in accordance with Section 4B.15.4.8. Such openings shall be separated vertically at least 1 m by spandrel girders, exterior walls or other similar assemblies that have a fire-resistance rating of at least 1 hour or by flame barriers that extend horizontally at least 0.75 m beyond the exterior wall. Flame barriers shall also have a fire-resistance rating of at least 1 hour. The unexposed surface temperature limitations specified in ASTM E 119 shall not apply to the flame barriers or vertical separation unless otherwise required by the provisions of these code requirements.

**Exceptions:**

- This section shall not apply to buildings that are three stories or less in height.
- This section shall not apply to buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.
- Open parking garages.

**4B.4.10 Vertical exposure.** For buildings on the same lot, approved protectives shall be provided in every opening that is less than 4.5 m vertically above the roof of an adjoining building or adjacent structure that is within a horizontal fire separation distance of 4.5 m of the wall in which the opening is located.

**Exception:** Opening protectives are not required where the roof construction has a fire-resistance rating of not less than 1 hour for a minimum distance of 3 m from the adjoining building and the entire length and span of the supporting elements for the fire-resistance-rated roof assembly has a fire-resistance rating of not less than 1 hour.

**4B.4.11 Parapets.** Parapets shall be provided on exterior walls of buildings.

**Exceptions:** A parapet need not be provided on an exterior wall where any of the following conditions exist:

1. The wall is not required to be fire-resistance rated in accordance with Table 4A.2 because of fire separation distance.
2. The building has an area of not more than 93 m<sup>2</sup> on any floor.
3. Walls that terminate at roofs of not less than 2-hour fire-resistance-rated construction or where the roof, including the deck and supporting construction, is constructed entirely of noncombustible materials.
4. One-hour fire-resistance-rated exterior walls that terminate at the underside of the roof sheathing, deck or slab, provided:
  - 4.1 Where the roof/ceiling framing elements are parallel to the walls, such framing and elements supporting such framing shall not be of less than 1-hour fire-resistance-rated construction for a width of 1.2 m measured from the interior side of the wall for Groups R and U and 3 m for other occupancies.
  - 4.2 Where roof/ceiling framing elements are not parallel to the wall, the entire span of such framing and elements supporting such framing shall not be of less than 1-hour fire-resistance-rated construction.
  - 4.3 Openings in the roof shall not be located within 1.5 m of the 1-hour fire-resistance-rated exterior wall for Groups R and U and 3 m for other occupancies.
  - 4.4 The entire building shall be provided with not less than a Class B roof covering.
5. In occupancies of Groups R-2 and R-3 as applicable in SBC 201, both provided with a Class C roof covering, the exterior wall shall be permitted to terminate at the roof sheathing or deck in Type III, IV and V construction provided:
  - 5.1 The roof sheathing or deck is constructed of approved noncombustible materials or of fire-retardant-treated wood, for a distance of 1.2 m; or
  - 5.2 The roof is protected with 16 mm Type X gypsum board directly beneath the underside of the roof sheathing or deck, supported by a minimum of nominal 50 mm ledgers attached to the sides of the roof framing members, for a minimum distance of 1.2 m.
6. Where the wall is permitted to have at least 25 percent of the exterior wall areas containing unprotected openings based on fire separation distance as determined in accordance with Section 4B.4.8.

**4B.4.11.1 Parapet construction.** Parapets shall have the same fire-resistance rating as that required for the supporting wall, and on any side adjacent to a roof surface, shall have noncombustible faces for the uppermost 500 mm, including counter flashing and coping materials. The height of the parapet shall not be less than 0.75 m above the point where the roof surface and the wall intersect. Where the roof slopes toward a parapet at a slope greater than two units vertical in 12 units horizontal (16.7-percent slope), the parapet shall extend to the same height as any portion of the roof within a fire separation distance where protection of wall openings is required, but in no case shall the height be less than 750 mm.

- 4B.4.12 Opening protection.** Windows required to be protected in accordance with Sections 4B.4.8, 4B.4.9, or 4B.4.10 shall comply with Section 4B.15.4.8. Other openings required to be protected with fire doors or shutters in accordance with Sections 4B.4.8, 4B.4.9 and 4B.4.10 shall comply with Section 4B.15.3.  
**Exception:** Fire protective assemblies are not required where the building is protected throughout by an automatic sprinkler system and the exterior openings are protected by an approved water curtain using automatic sprinklers approved for that use. The sprinklers and the water curtain shall be installed in accordance with NFPA 13.
- 4B.4.12.1 Unprotected openings.** Where protected openings are not required by Section 4B.4, windows and doors shall be constructed of any approved materials. Glazing shall conform to the requirements of Chapter 11 of the SBC 201.
- 4B.4.13 Joints.** Joints made in or between exterior walls required by this section to have a fire-resistance rating shall comply with Section 4B.13.  
**Exception:** Joints in exterior walls that are permitted to have unprotected openings.
- 4B.4.13.1 Voids.** The void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly shall be protected in accordance with Section 4B.13.4.
- 4B.4.14 Ducts and air transfer openings.** Penetrations by air ducts and air transfer openings in fire-resistance-rated exterior walls required to have protected openings shall comply with Section 4B.16.  
**Exception:** Foundation vents installed in accordance with these code requirements are permitted.

## SECTION 4B.5 FIRE WALLS

- 4B.5.1 General.** Each portion of a building separated by one or more fire walls that comply with the provisions of this section shall be considered a separate building. The extent and location of such fire walls shall provide a complete separation. Where a fire wall also separates groups that are required to be separated by a fire barrier wall, the most restrictive requirements of each separation shall apply. Fire walls located on lot lines shall also comply with Section 3.3.2. Such fire walls (party walls) shall be constructed without openings.
- 4B.5.2 Structural stability.** Fire walls shall have sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall for the duration of time indicated by the required fire-resistance rating.
- 4B.5.3 Materials.** Fire walls shall be of any approved noncombustible materials.  
**Exception:** Buildings of Type V construction.
- 4B.5.4 Fire-resistance rating.** Fire walls shall have a fire-resistance rating of not less than that required by Table 4B.5.4.

**TABLE 4B.5.4**  
**FIRE WALL FIRE-RESISTANCE RATINGS**

<b>GROUP</b>	<b>FIRE-RESISTANCE RATING (hours)</b>
A, B, E, H-4, I, R-1, R-2, U	3 <sup>a</sup>
F-1, H-3 <sup>b</sup> , H-5, M, S-1	3
H-1, H-2	4 <sup>b</sup>
F-2, S-2, R-3, R-4	2

- a. Walls shall be not less than 2-hour fire-resistance rated where separating buildings of Type II or V construction.
- b. For Group H-1, H-2 or H-3 buildings, also see Sections 2B.15.4 and 2B.15.5.

**4B.5.5 Horizontal continuity.** Fire walls shall be continuous from exterior wall to exterior wall and shall extend at least 500 mm beyond the exterior surface of exterior walls.

**Exceptions:**

1. Fire walls shall be permitted to terminate at the interior surface of combustible exterior sheathing or siding provided the exterior wall has a fire-resistance rating of at least 1 hour for a horizontal distance of at least 1.2 m on both sides of the fire wall. Openings within such exterior walls shall be protected by fire assemblies having a fire protection rating of not less than 3/4 hour.
2. Fire walls shall be permitted to terminate at the interior surface of noncombustible exterior sheathing, exterior siding or other noncombustible exterior finishes provided the sheathing, siding, or other exterior noncombustible finish extends a horizontal distance of at least 1.2 m on both sides of the fire wall.
3. Fire walls shall be permitted to terminate at the interior surface of noncombustible exterior sheathing where the building on each side of the fire wall is protected by an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

**4B.5.5.1 Exterior walls.** Where the fire wall intersects the exterior walls, the fire-resistance rating for the exterior walls on both sides of the fire wall shall have a 1-hour fire-resistance rating with 3/4-hour opening protection where opening protection is required. The fire-resistance rating of the exterior wall shall extend a minimum of 1.2 m on each side of the intersection of the fire wall to exterior wall. Exterior wall intersections at fire walls that form an angle equal to or greater than 180 degrees (3.14 rad) do not need exterior wall protection.

**4B.5.5.2 Horizontal projecting elements.** Fire walls shall extend to the outer edge of horizontal projecting elements such as balconies, roof overhangs, canopies, marquees and architectural projections that are within 1.2 m of the fire wall.

**Exceptions:**

1. Horizontal projecting elements without concealed spaces provided the exterior wall behind and below the projecting element has not less than 1-hour fire-resistance-rated construction for a distance not less than the depth of the projecting element on both sides of the firewall. Openings within such exterior walls shall be protected by fire assemblies having a fire protection rating of not less than 3/4 hour.
2. Noncombustible horizontal projecting elements with concealed spaces, provided a minimum 1-hour fire-resistance-rated wall extends through the concealed space. The projecting element shall be separated from the building by a minimum of 1-hour fire-resistance-rated construction for a distance on each side of the firewall equal to the depth of the projecting element. The wall

is not required to extend under the projecting element where the building exterior wall is not less than 1-hour fire-resistance-rated for a distance on each side of the firewall equal to the depth of the projecting element. Openings within such exterior walls shall be protected by fire assemblies having a fire protection rating of not less than 3/4 hour.

3. For combustible horizontal projecting elements with concealed spaces, the fire wall need only extend through the concealed space to the outer edges of the projecting elements. The exterior wall behind and below the projecting element shall be of not less than 1-hour fire-resistance-rated construction for a distance not less than the depth of the projecting elements on both sides of the fire wall. Openings within such exterior walls shall be protected by fire assemblies having a fire-protection rating of not less than 3/4 hour.

**4B.5.6 Vertical continuity.** Fire walls shall extend from the foundation to a termination point at least 750 mm above both adjacent roofs.

**Exceptions:**

1. Stepped buildings in accordance with Section 4B.5.6.1.
2. Two-hour walls shall be permitted to terminate at the underside of the roof sheathing, deck or slab provided:
  - 2.1 The lower roof assembly within 1.2 m of the wall has not less than a 1-hour fire-resistance rating and the entire length and span of supporting elements for the rated roof assembly has a fire-resistance rating of not less than 1 hour.
  - 2.2 Openings in the roof shall not be located within 1.2 m of the fire wall.
  - 2.3 Each building shall be provided with not less than a Class B roof covering.
3. Walls shall be permitted to terminate at the underside of noncombustible roof sheathing, deck, or slabs where both buildings are provided with not less than a Class B roof covering. Openings in the roof shall not be located within 1.2 m of the fire wall.
4. In buildings of Type III, IV and V construction, walls shall be permitted to terminate at the underside of combustible roof sheathing or decks provided:
  - 4.1 There are no openings in the roof within 1.2 m of the fire wall,
  - 4.2 The roof is covered with a minimum Class B roof covering, and
  - 4.3 The roof sheathing or deck is constructed of fire-retardant-treated wood for a distance of 1.2 m on both sides of the wall or the roof is protected with 16 mm Type X gypsum board directly beneath the underside of the roof sheathing or deck, supported by a minimum of 50 mm ledgers attached to the sides of the roof framing members for a minimum distance of 1.2 m on both sides of the fire wall.
5. Buildings located above a parking garage designed in accordance with Section 3.8.2 shall be permitted to have the fire walls for the buildings located above the parking garage extend from the horizontal separation between the parking garage and the buildings.

**4B.5.6.1 Stepped buildings.** Where a fire wall serves as an exterior wall for a building and separates buildings having different roof levels, such wall shall terminate at a point not less than 750 mm above the lower roof level, provided the exterior wall for a height of 4.5 m above the lower roof is not less than 1-hour fire-resistance-rated construction from both sides with openings protected by assemblies having a 3/4-hour fire protection rating.

**Exception:** Where the fire wall terminates at the underside of the roof sheathing, deck or slab of the lower roof, provided:

1. The lower roof assembly within 3 m of the wall has not less than a 1-hour fire-resistance rating and the entire length and span of supporting elements for the rated roof assembly has a fire-resistance rating of not less than 1 hour.
2. Openings in the lower roof shall not be located within 3 m of the fire wall.

**4B.5.7 Combustible framing in fire walls.** Adjacent combustible members entering into a concrete or masonry firewall from opposite sides shall not have less than a 100 mm distance between embedded ends. Where combustible members frame into hollow walls or walls of hollow units, hollow spaces shall be solidly filled for the full thickness of the wall and for a distance not less than 100 mm above, below and between the structural members, with noncombustible materials approved for fire blocking.

**4B.5.8 Openings.** Each opening through a firewall shall be protected in accordance with Section 4B.15.3 and shall not exceed 11 m<sup>2</sup>. The aggregate width of openings at any floor level shall not exceed 25 percent of the length of the wall.

**Exceptions:**

1. Openings are not permitted in party walls constructed in accordance with Section 3.3.2.
2. Openings shall not be limited to 11 m<sup>2</sup> where both buildings are equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1.

**4B.5.9 Penetrations.** Penetrations through firewalls shall comply with Section 4B.12.

**4B.5.10 Joints.** Joints made in or between fire walls shall comply with Section 4B.13.

**4B.5.11 Ducts and air transfer openings.** Ducts and air transfer openings shall not penetrate fire walls.

**Exception:** Penetrations by ducts and air transfer openings of fire walls that are not on a lot line shall be allowed provided the penetrations comply with Sections 4B.12 and 4B.16. The size and aggregate width of all openings shall not exceed the limitations of Section 4B.5.8.

## **SECTION 4B.6 FIRE BARRIERS**

**4B.6.1 General.** Fire barriers used for separation of shafts, exits, exit passageways, horizontal exits or incidental use areas, to separate different occupancies, to separate a single occupancy into different fire areas, or to separate other areas where a fire barrier is required elsewhere in these code requirements or the SBC 201, shall comply with this section.

**4B.6.2 Materials.** The walls and floor assemblies shall be of materials permitted by the building type of construction.

**4B.6.3 Fire-resistance rating.** The fire-resistance rating of the walls and floor assemblies shall comply with this section.

**4B.6.3.1 Shaft enclosures.** The fire-resistance rating of the fire barrier separating building areas from a shaft shall comply with Section 4B.7.4.

**4B.6.3.2 Exit enclosures.** The fire-resistance rating of the fire barrier separating building areas from an exit shall comply with Section 8.19.1.



- 4B.6.3.3 Exit passageway.** The fire-resistance rating of the separation between building areas and an exit passageway shall comply with Section 8.20.1.
- 4B.6.3.4 Horizontal exit.** The fire-resistance rating of the separation between building areas connected by a horizontal exit shall comply with Section 8.21.1.
- 4B.6.3.5 Incidental use areas.** The fire barrier separating incidental use areas shall have a fire-resistance rating of not less than that indicated in Table 2A.2.1.1.
- 4B.6.3.6 Separation of mixed occupancies.** Where the provisions of Section 2A.2.3.2 are applicable, the fire barrier separating mixed occupancies shall have a fire-resistance rating of not less than that indicated in Section 2A.2.3.2 based on the occupancies being separated.
- 4B.6.3.7 Single-occupancy fire areas.** The fire barrier separating a single occupancy into different fire areas shall have a fire-resistance rating of not less than that indicated in Table 4B.6.3.7.

**TABLE 4B.6.3.7  
FIRE-RESISTANCE RATING REQUIREMENTS FOR FIRE  
BARRIER ASSEMBLIES BETWEEN FIRE AREAS**

<b>OCCUPANCY GROUP</b>	<b>FIRE-RESISTANCE RATING (hours)</b>
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

- 4B.6.4 Continuity of fire barrier walls.** Fire barrier walls shall extend from the top of the floor/ceiling assembly below to the underside of the floor or roof slab or deck above and shall be securely attached thereto. These walls shall be continuous through concealed spaces such as the space above a suspended ceiling. The supporting construction for fire barrier walls shall be protected to afford the required fire-resistance rating of the fire barrier supported except for 1-hour fire-resistance-rated incidental use area separations as required by Table 2A.2.1.1 in buildings of Type IIB, IIIB and VB construction. Hollow vertical spaces within the fire barrier wall shall be fire stopped at every floor level.

**Exceptions:**

1. The maximum required fire-resistance rating for assemblies supporting fire barriers separating tank storage as provided for in Section 2B.15.7.2.1 shall be 2 hours, but not less than required by Table 4A.1 for the building construction type.
2. Shaft enclosure shall be permitted to terminate at a top enclosure complying with Section 4B.7.12.

- 4B.6.5 Horizontal fire barriers.** Horizontal fire barriers shall be constructed in accordance with Section 4B.11.

- 4B.6.6 Exterior walls.** Where exterior walls serve as a part of a required fire-resistance-rated enclosure, such walls shall comply with the requirements of Section 4B.4 for exterior walls and the fire-resistance-rated enclosure requirements shall not apply.  
**Exception:** Exterior walls required to be fire-resistance-rated in accordance with Section 8.22.6.

- 4B.6.7 Openings.** Openings in a fire barrier wall shall be protected in accordance with Section 4B.14. Openings shall be limited to a maximum aggregate width of 25

percent of the length of the wall, and the maximum area of any single opening shall not exceed 11 m<sup>2</sup>. Openings in exit enclosures shall also comply with Section 8.20.4.

**Exceptions:**

1. Openings shall not be limited to 11 m<sup>2</sup> where adjoining fire areas are equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
2. Fire doors serving an exit enclosure.
3. Openings shall not be limited to 11 m<sup>2</sup> or an aggregate width of 25 percent of the length of the wall where the opening protective assembly has been tested in accordance with ASTM E 119 and has a minimum fire-resistance rating not less than the fire-resistance rating of the wall.

**4B.6.8 Penetrations.** Penetrations through fire barriers shall comply with Section 4B.12.

**4B.6.8.1 Prohibited penetrations.** Penetrations into an exit enclosure shall only be allowed when permitted by Section 8.20.5.

**4B.6.9 Joints.** Joints made in or between fire barriers shall comply with Section 4B.13.

**4B.6.10 Ducts and air transfer openings.** Penetrations by ducts and air transfer openings shall comply with Sections 4B.12 and 4B.16.

## SECTION 4B.7 SHAFT ENCLOSURES

**4B.7.1 General.** The provisions of this section shall apply to vertical shafts where such shafts are required to protect openings and penetrations through floor/ceiling and roof/ceiling assemblies.

**4B.7.2 Shaft enclosure required.** Openings through a floor/ceiling assembly shall be protected by a shaft enclosure complying with this section.

**Exceptions:**

1. A shaft enclosure is not required for openings totally within an individual residential dwelling unit and connecting four stories or less.
2. A shaft enclosure is not required in a building equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 for an escalator opening or stairway which is not a portion of the means of egress protected according to Item 2.1 or 2.2:
  - 2.1 Where the area of the floor opening between stories does not exceed twice the horizontal projected area of the escalator or stairway and the opening is protected by a draft curtain and closely spaced sprinklers in accordance with NFPA 13. In other than Groups B and M, this application is limited to openings that do not connect more than four stories.
  - 2.2 Where the opening is protected by approved power-operated automatic shutters at every floor penetrated. The shutters shall be of noncombustible construction and have a fire-resistance rating of not less than 1.5 hours. The shutter shall be so constructed as to close immediately upon the actuation of a smoke detector installed in accordance with Section 7.7.11 and shall completely shutoff the well opening. Escalators shall cease operation when the shutter begins to close. The shutter shall operate at a speed of not more than 150 mm/s and shall be equipped with a sensitive leading edge to arrest its progress

where in contact with any obstacle, and to continue its progress on release therefrom.

3. A shaft enclosure is not required for penetrations by pipe, tube, conduit, wire, cable, and vents protected in accordance with Section 4B.12.4.
4. A shaft enclosure is not required for penetrations by ducts protected in accordance with Section 4B.12.4. Grease ducts shall be protected in accordance with the SBC 501.
5. A shaft enclosure is not required for floor openings complying with the provisions for covered malls or atriums.
6. A shaft enclosure is not required for approved masonry chimneys, where annular space protection is provided at each floor level in accordance with Section 4B.17.2.5.
7. In other than Groups I-2 and I-3, a shaft enclosure is not required for a floor opening that complies with the following:
  - 7.1 Does not connect more than two stories.
  - 7.2 Is not part of the required means of egress system except as permitted in Section 8.19.1.
  - 7.3 Is not concealed within the building construction.
  - 7.4 Is not open to a corridor in Group I and R occupancies.
  - 7.5 Is not open to a corridor on nonsprinklered floors in any occupancy.
  - 7.6 Is separated from floor openings serving other floors by construction conforming to required shaft enclosures.
8. A shaft enclosure is not required for automobile ramps in open parking garages and enclosed parking garages constructed in accordance with Sections 2B.6.3 and 2B.6.4, respectively.
9. A shaft enclosure is not required for floor openings between a mezzanine and the floor below.
10. A shaft enclosure is not required for joints protected by a fire-resistant joint system in accordance with Section 4B.13.
11. Where permitted by other sections of these code requirements.

**4B.7.3 Materials.** The shaft enclosure shall be of materials permitted by the building type of construction.

**4B.7.4 Fire-resistance rating.** Shaft enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more and not less than 1 hour where connecting less than four stories. The number of stories connected by the shaft enclosure shall include any basements but not any mezzanines. Shaft enclosures shall be constructed as fire barriers in accordance with Section 4B.6. Shaft enclosures shall have a fire-resistance rating not less than the floor assembly penetrated, but need not exceed 2 hours.

**4B.7.5 Continuity.** Shaft enclosure walls shall extend from the top of the floor/ceiling assembly below to the underside of the floor or roof slab or deck above and shall be securely attached thereto. These walls shall be continuous through concealed spaces such as the space above a suspended ceiling. The supporting construction shall be protected to afford the required fire-resistance rating of the element supported. Hollow vertical spaces within the shaft enclosure construction wall shall be fire stopped at every floor level.

**4B.7.6 Exterior walls.** Where exterior walls serve as a part of a required shaft enclosure, such walls shall comply with the requirements of Section 4B.4 for exterior walls and the fire-resistance-rated enclosure requirements shall not apply.

**Exception:** Exterior walls required to be fire-resistance rated in accordance with Section 8.22.6.

**4B.7.7 Openings.** Openings in a shaft enclosure shall be protected in accordance with Section 4B.15 as required for fire barriers. Such openings shall be self-closing or automatic-closing by smoke detection.

**4B.7.7.1 Prohibited openings.** Openings other than those necessary for the purpose of the shaft shall not be permitted in shaft enclosures.

**4B.7.8 Penetrations.** Penetrations in a shaft enclosure shall be protected in accordance with Section 4B.12 as required for fire barriers.

**4B.7.8.1 Prohibited penetrations.** Penetrations other than those necessary for the purpose of the shaft shall not be permitted in shaft enclosures. Ducts shall not penetrate exit shaft enclosures.

**Exception:** Duct penetrations as permitted in Section 8.20.5.

**4B.7.9 Joints.** Joints in a shaft enclosure shall comply with Section 4B.13.

**4B.7.10 Ducts and air transfer openings.** Penetrations of a shaft enclosure by ducts and air transfer openings shall comply with Sections 4B.12 and 4B.16.

**4B.7.11 Enclosure at the bottom.** Shafts that do not extend to the bottom of the building or structure shall:

1. Be enclosed at the lowest level with construction of the same fire-resistance rating as the lowest floor through which the shaft passes, but not less than the rating required for the shaft enclosure;
2. Terminate in a room having a use related to the purpose of the shaft. The room shall be separated from the remainder of the building by construction having a fire-resistance rating and opening protectives at least equal to the protection required for the shaft enclosure; or
3. Be protected by approved fire dampers installed in accordance with their listing at the lowest floor level within the shaft enclosure.

**Exceptions:**

1. The fire-resistance-rated room separation is not required provided there are no openings in or penetrations of the shaft enclosure to the interior of the building except at the bottom. The bottom of the shaft shall be closed off around the penetrating items with materials permitted by Section 4B.17.3.1 for draft stopping, or the room shall be provided with an approved automatic fire suppression system.
2. A shaft enclosure containing a refuse chute or laundry chute shall not be used for any other purpose and shall terminate in a room protected in accordance with Section 4B.7.13.4.
3. The fire-resistance-rated room separation and the protection at the bottom of the shaft are not required provided there are no combustibles in the shaft and there are no openings or other penetrations through the shaft enclosure to the interior of the building.

**4B.7.12 Enclosure at the top.** A shaft enclosure that does not extend to the underside of the roof deck of the building shall be enclosed at the top with construction of the same fire-resistance rating as the topmost floor penetrated by the shaft, but not less than the fire-resistance rating required for the shaft enclosure.

- 4B.7.13 Refuse and laundry chutes.** Refuse and laundry chutes, access and termination rooms and incinerator rooms shall meet the requirements of Sections 4B.7.13.1 through 4B.7.13.6.
- Exception:** Chutes serving and contained within a single dwelling unit.
- 4B.7.13.1 Refuse and laundry chute enclosures.** A shaft enclosure containing a refuse or laundry chute shall not be used for any other purpose and shall be enclosed in accordance with Section 4B.7.4. Openings into the shaft, including those from access rooms and termination rooms, shall be protected in accordance with this section and Section 4B.15. Openings into chutes shall not be located in exit access corridors. Opening protectives shall be self-closing or automatic-closing upon the actuation of a smoke detector installed in accordance with Section 7.7.10, except that heat-activated closing devices shall be permitted between the shaft and the termination room.
- 4B.7.13.2 Materials.** A shaft enclosure containing a refuse or laundry chute shall be constructed of materials as permitted by the building type of construction.
- 4B.7.13.3 Refuse and laundry chute access rooms.** Access openings for refuse and laundry chutes shall be located in rooms or compartments completely enclosed by construction that has a fire-resistance rating of not less than 1 hour and openings into the access rooms shall be protected by opening protectives having a fire protection rating of not less than 3/4 hour and shall be self-closing or automatic-closing upon the detection of smoke.
- 4B.7.13.4 Termination room.** Refuse and laundry chutes shall discharge into an enclosed room completely separated from the remainder of the building by construction that has a fire-resistance rating of not less than 1 hour and openings into the termination room shall be protected by opening protectives having a fire protection rating of not less than 3/4 hour and shall be self-closing or automatic-closing upon the detection of smoke. Refuse chutes shall not terminate in an incinerator room. Refuse and laundry rooms that are not provided with chutes need only comply with Table 2A.2.1.1.
- 4B.7.13.5 Incinerator room.** Incinerator rooms shall comply with Table 2A.2.1.1.
- 4B.7.13.6 Automatic fire sprinkler system.** An approved automatic fire sprinkler system shall be installed in accordance with Section 7.3.2.10.2.
- 4B.7.14 Elevator and dumbwaiter shafts.** Elevator hoist way and dumbwaiter enclosures shall be constructed in accordance with Section 4B.7.4 and SBC 501.
- 4B.7.14.1 Elevator lobby.** Elevators opening into a fire-resistance-rated corridor as required by Section 8.16.1 shall be provided with an elevator lobby at each floor containing such a corridor. The lobby shall separate the elevators from the corridor by fire partitions and the required opening protection. Elevator lobbies shall have at least one means of egress complying with Chapter 8 and other provisions within these code requirements.
- Exceptions:**
1. In office buildings, separations are not required from a street-floor elevator lobby provided the entire street floor is equipped with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
  2. Elevators not required to be located in a shaft in accordance with Section 4B.7.2.
  3. Where additional doors are provided in accordance with SBC 501. Such doors shall be tested in accordance with UL 1784 without an artificial bottom seal.
  4. In other than Group I-3, and buildings more than four stories above the lowest level of Civil Defence vehicle access, lobby separation is not required where the building, including the lobby and corridors leading to the lobby, is

protected by an automatic sprinkler system installed throughout in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

## SECTION 4B.8 FIRE PARTITIONS

- 4B.8.1 General.** The following wall assemblies shall comply with this section:
1. Walls separating dwelling units in the same building.
  2. Walls separating sleeping units in occupancies in Group R-1, hotel occupancies, R-2 and I-1.
  3. Walls separating tenant spaces in covered mall buildings as required by Section 2B.2.7.2.
  4. Corridor walls as required by Section 8.16.1.
- 4B.8.2 Materials.** The walls shall be of materials permitted by the building type of construction.
- 4B.8.3 Fire-resistance rating.** The fire-resistance rating of the walls shall be 1 hour.
- Exceptions:**
1. Corridor walls as permitted by Table 8.16.1.
  2. Dwelling unit and sleeping unit separations in buildings of Type IIB, IIIB and VB construction shall have fire-resistance ratings of not less than  $\frac{1}{2}$  hour in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
- 4B.8.4 Continuity.** Fire partitions shall extend from the top of the floor assembly below to the underside of the floor or roof slab or deck above or to the fire-resistance-rated floor/ceiling or roof/ceiling assembly above, and shall be securely attached thereto. If the partitions are not continuous to the deck, and where constructed of combustible construction, the space between the ceiling and the deck above shall be fire blocked or draft stopped in accordance with Sections 4B.17.2.1 and 4B.17.3.1 at the partition line. The supporting construction shall be protected to afford the required fire-resistance rating of the wall supported, except for tenant and sleeping unit separation walls and exit access corridor walls in buildings of Type IIB, IIIB and VB construction.
- Exceptions:**
1. The wall need not be extended into the crawl space below where the floor above the crawl space has a minimum 1-hour fire-resistance rating.
  2. Where the room-side fire-resistance-rated membrane of the corridor is carried through to the underside of a fire-resistance-rated floor or roof above, the ceiling of the corridor shall be permitted to be protected by the use of ceiling materials as required for a 1-hour fire-resistance-rated floor or roof system.
  3. Where the corridor ceiling is constructed as required for the corridor walls, the walls shall be permitted to terminate at the upper membrane of such ceiling assembly.
  4. The fire partition separating tenant spaces in a mall, complying with Section 2B.2.7.2, is not required to extend beyond the underside of a ceiling that is not part of a fire-resistance-rated assembly. A wall is not required in attic or ceiling spaces above tenant separation walls.
  5. Fire blocking or draft stopping is not required at the partition line in Group R-2 buildings that do not exceed four stories in height provided the attic space is subdivided by draft stopping into areas not exceeding 279 m<sup>2</sup> or above every two dwelling units, whichever is smaller.

6. Fire blocking or draft stopping is not required at the partition line in buildings equipped with an automatic sprinkler system installed throughout in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 provided that automatic sprinklers are installed in combustible floor/ceiling and roof/ceiling spaces.

- 4B.8.5 Exterior walls.** Where exterior walls serve as a part of a required fire-resistance-rated enclosure, such walls shall comply with the requirements of Section 4B.4 for exterior walls and the fire-resistance-rated enclosure requirements shall not apply.
- 4B.8.6 Openings.** Openings in a fire partition shall be protected in accordance with Section 4B.15.
- 4B.8.7 Penetrations.** Penetrations through fire partitions shall comply with Section 4B.12.
- 4B.8.8 Joints.** Joints made in or between fire partitions shall comply with Section 4B.13.
- 4B.8.9 Ducts and air transfer openings.** Penetrations by ducts and air transfer openings shall comply with Sections 4B.12 and 4B.16.

## SECTION 4B.9 SMOKE BARRIERS

- 4B.9.1 General.** Smoke barriers shall comply with this section.
- 4B.9.2 Materials.** Smoke barriers shall be of materials permitted by the building type of construction.
- 4B.9.3 Fire-resistance rating.** A 1-hour fire-resistance rating is required for smoke barriers.  
**Exception:** Smoke barriers constructed of minimum 2.5-mm-thick steel in Group I-3 buildings.
- 4B.9.4 Continuity.** Smoke barriers shall form an effective membrane continuous from outside wall to outside wall and from floor slab to floor or roof deck above, including continuity through concealed spaces, such as those found above suspended ceilings, and interstitial structural and mechanical spaces. The supporting construction shall be protected to afford the required fire-resistance rating of the wall or floor supported in buildings of other than Type IIB, IIIB or VB construction.  
**Exception:** Smoke barrier walls are not required in interstitial spaces where such spaces are designed and constructed with ceilings that provide resistance to the passage of fire and smoke equivalent to that provided by the smoke barrier walls.
- 4B.9.5 Openings.** Openings in a smoke barrier shall be protected in accordance with Section 4B.15.  
**Exception:** In Group I-2, where such doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with approved fire-resistance-rated glazing materials in approved fire-resistance-rated frames, the area of which shall not exceed that tested. The doors shall be close fitting within operational tolerances, and shall not have undercuts, louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges and automatic-closing devices. Positive-latching devices are not required.

- 4B.9.6 Penetrations.** Penetrations through smoke barriers shall comply with Section 4B.12.
- 4B.9.7 Joints.** Joints made in or between smoke barriers shall comply with Section 4B.13.
- 4B.9.8 Duct and air transfer openings.** Penetrations by duct and air transfer openings shall comply with Sections 4B.12 and 4B.16.

### SECTION 4B.10 SMOKE PARTITIONS

- 4B.10.1 General.** Smoke partitions installed as required elsewhere in the code shall comply with this section.
- 4B.10.2 Materials.** The walls shall be of materials permitted by the building type of construction.
- 4B.10.3 Fire-resistance rating.** Unless required elsewhere in the code, smoke partitions are not required to have a fire-resistance rating.
- 4B.10.4 Continuity.** Smoke partitions shall extend from the floor to the underside of the floor or roof deck above or to the underside of the ceiling above where the ceiling membrane is constructed to limit the transfer of smoke.
- 4B.10.5 Openings.** Windows shall be sealed to resist the free passage of smoke or be automatic-closing upon detection of smoke. Doors in smoke partitions shall comply with this section.
  - 4B.10.5.1 Louvers.** Doors in smoke partitions shall not include louvers.
  - 4B.10.5.2 Smoke and draft-control doors.** Where required elsewhere in the code, doors in smoke partitions shall be tested in accordance with UL 1784 with an artificial bottom seal installed across the full width of the bottom of the door assembly. The air leakage rate of the door assembly shall not exceed 0.0154 cubic meter per second per square meter ( $\text{m}^3/\text{s}/\text{m}^2$ ) [ $15.4 (\text{mm}^3/\text{s}/\text{mm}^2)$ ] of door opening at 25 Pa for both the ambient temperature test.
  - 4B.10.5.3 Self-closing or automatic-closing doors.** Where required elsewhere in the code, doors in smoke partitions shall be self-closing or automatic-closing in accordance with Section 4B.15.3.7.3.
- 4B.10.6 Penetrations and joints.** The space around penetrating items and in joints shall be filled with an approved material to limit the free passage of smoke.
- 4B.10.7 Ducts and air transfer openings.** Air transfer openings in smoke partitions shall be provided with a smoke damper complying with Section 4B.16.3.2.  
**Exception:** Where the installation of a smoke damper will interfere with the operation of a required smoke control system in accordance with Section 7.9, approved alternative protection shall be utilized.

### SECTION 4B.11 HORIZONTAL ASSEMBLIES

- 4B.11.1 General.** Floor and roof assemblies required to have a fire-resistance rating shall comply with this section.
- 4B.11.2 Materials.** The floor and roof assemblies shall be of materials permitted by the



building type of construction.

**4B.11.3 Fire-resistance rating.** The fire-resistance rating of floor and roof assemblies shall not be less than that required by the building type of construction. Where the floor assembly separates mixed occupancies, the assembly shall have a fire-resistance rating of not less than that required by Section 2A.2.3.2 based on the occupancies being separated. Where the floor assembly separates a single occupancy into different fire areas, the assembly shall have a fire-resistance rating of not less than that required by Section 4B.6.3.7. Floor assemblies separating dwelling units in the same building or sleeping units in occupancies in Group R-1, hotel occupancies, R-2 and I-1 shall be a minimum of 1-hour fire-resistance-rated construction.

**Exception:** Dwelling unit and sleeping unit separations in buildings of Type IIB, IIIB, and VB construction shall have fire-resistance ratings of not less than 1/2 hour in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

**4B.11.3.1 Ceiling panels.** Where the weight of lay-in ceiling panels, used as part of fire-resistance-rated floor/ceiling or roof/ceiling assemblies, is not adequate to resist an upward force of 48 Pa, wire or other approved devices shall be installed above the panels to prevent vertical displacement under such upward force.

**4B.11.3.2 Access doors.** Access doors shall be permitted in ceilings of fire-resistance-rated floor/ceiling and roof/ceiling assemblies provided such doors are tested in accordance with ASTM E 119 as horizontal assemblies and labeled by an approved agency for such purpose.

**4B.11.3.3 Unusable space.** In 1-hour fire-resistance-rated floor construction, the ceiling membrane is not required to be installed over unusable crawl spaces. In 1-hour fire-resistance-rated roof construction, the floor membrane is not required to be installed where unusable attic space occurs above.

**4B.11.4 Continuity.** Assemblies shall be continuous without openings, penetrations or joints except as permitted by this section and Sections 4B.7.2, 4B.12.4 and 4B.13. Skylights and other penetrations through a fire-resistance-rated roof deck are permitted to be unprotected, provided that the structural integrity of the fire-resistance-rated roof construction is maintained. Unprotected skylights shall not be permitted in roof construction required to be fire-resistance rated in accordance with Section 4B.4.10. The supporting construction shall be protected to afford the required fire-resistance rating of the horizontal assembly supported.

**4B.11.5 Penetrations.** Penetrations through fire-resistance-rated horizontal assemblies shall comply with Section 4B.12.

**4B.11.6 Joints.** Joints made in or between fire-resistance-rated horizontal assemblies shall comply with Section 4B.13. The void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly shall be protected in accordance with Section 4B.13.4.

**4B.11.7 Ducts and air transfer openings.** Penetrations by ducts and air transfer openings shall comply with Sections 4B.12 and 4B.16.

## SECTION 4B.12 PENETRATIONS

**4B.12.1 Scope.** The provisions of this section shall govern the materials and methods of

construction used to protect through penetrations and membrane penetrations.

**4B.12.2 Installation details.** Where sleeves are used, they shall be securely fastened to the assembly penetrated. The space between the item contained in the sleeve and the sleeve itself and any space between the sleeve and the assembly penetrated shall be protected in accordance with this section. Insulation and coverings on or in the penetrating item shall not penetrate the assembly unless the specific material used has been tested as part of the assembly in accordance with this section.

**4B.12.3 Fire-resistance-rated walls.** Penetrations into or through fire walls, fire barriers, smoke barrier walls, and fire partitions shall comply with this section.

**4B.12.3.1 Through penetrations.** Through penetrations of fire-resistance-rated walls shall comply with Section 4B.12.3.1.1 or 4B.12.3.1.2.

**Exception:** Where the penetrating items are steel, ferrous or copper pipes or steel conduits, the annular space between the penetrating item and the fire-resistance-rated wall shall be permitted to be protected as follows:

1. In concrete or masonry walls where the penetrating item is a maximum 150 mm nominal diameter and the opening is a maximum 0.093 m<sup>2</sup>, concrete, grout or mortar shall be permitted where installed the full thickness of the wall or the thickness required to maintain the fire-resistance rating; or
2. The material used to fill the annular space shall prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 2.5 Pa at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.

**4B.12.3.1.1 Fire-resistance-rated assemblies.** Penetrations shall be installed as tested in an approved fire-resistance-rated assembly.

**4B.12.3.1.2 Through-penetration firestop system.** Through penetrations shall be protected by an approved penetration fire stop system installed as tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 2.5 Pa of water and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.

**4B.12.3.2 Membrane penetrations.** Membrane penetrations shall comply with Section 4B.12.3.1. Where walls and partitions are required to have a minimum 1-hour fire-resistance rating, recessed fixtures shall be installed such that the required fire resistance will not be reduced.

**Exceptions:**

1. Steel electrical boxes that do not exceed 0.0103 m<sup>2</sup> in area provided the total area of such openings does not exceed 0.0645 m<sup>2</sup> for any 9.3 m<sup>2</sup> of wall area. Outlet boxes on opposite sides of the wall shall be separated as shown:
  - 1.1 By a horizontal distance of not less than 600 mm;
  - 1.2 By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose fill, rock wool or slag mineral wool insulation;
  - 1.3 By solid fire blocking in accordance with Section 4B.17.2.1;
  - 1.4 By protecting both outlet boxes by listed putty pads; or
  - 1.5 By other listed materials and methods.
2. Membrane penetrations for listed electrical outlet boxes of any material are permitted provided such boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing. Outlet boxes on opposite sides of the wall shall be separated as follows:
  - 2.1 By a horizontal distance of not less than 600 mm;

- 2.2 By solid fire blocking in accordance with Section 4B.17.2.1;
- 2.3 By protecting both outlet boxes by listed putty pads; or
- 2.4 By other listed materials and methods.
- 3. The annular space created by the penetration of a fire sprinkler provided it is covered by a metal escutcheon plate.
- 4B.12.3.3 **Ducts and air transfer openings.** Penetrations of fire-resistance-rated walls by ducts and air transfer openings that are not protected with fire dampers shall comply with this section.
- 4B.12.3.4 **Dissimilar materials.** Noncombustible penetrating items shall not connect to combustible items beyond the point of fire stopping unless it can be demonstrated that the fire-resistance integrity of the wall is maintained.
- 4B.12.4 **Horizontal assemblies.** Penetrations of a floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected in accordance with Section 4B.7. Penetrations permitted by Exceptions 3 and 4 of Section 4B.7.2 shall comply with Sections 4B.12.4.1 through 4B.12.4.4.  
**Exception:** Penetrations located within the same room or undivided area as floor openings not required to have a shaft enclosure in accordance with Exception 1, 2, 5, 7, 8 or 9 in Section 4B.7.2.
- 4B.12.4.1 **Through penetrations.** Through penetrations of fire-resistance-rated horizontal assemblies shall comply with Section 4B.12.4.1.1 or 4B.12.4.1.2.  
**Exceptions:**
  - 1. Penetrations by steel, ferrous or copper conduits, pipes, tubes, vents, concrete, or masonry through a single fire-resistance-rated floor assembly where the annular space is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 2.5 Pa at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated. Penetrating items with a maximum 150 mm nominal diameter shall not be limited to the penetration of a single fire-resistance-rated floor assembly provided that the area of the penetration does not exceed 0.093 m<sup>2</sup> in any 9.3 m<sup>2</sup> of floor area.
  - 2. Penetrations in a single concrete floor by steel, ferrous or copper conduits, pipes, tubes and vents with a maximum 150 mm nominal diameter provided concrete, grout or mortar is installed the full thickness of the floor or the thickness required to maintain the fire-resistance rating. The penetrating items with a maximum 150 mm nominal diameter shall not be limited to the penetration of a single concrete floor provided that the area of the penetration does not exceed 0.093 m<sup>2</sup>.
  - 3. Electrical outlet boxes of any material are permitted provided that such boxes are tested for use in fire-resistance-rated assemblies and installed in accordance with the tested assembly.
- 4B.12.4.1.1 **Fire-resistance-rated assemblies.** Penetrations shall be installed as tested in the approved fire-resistance-rated assembly.
- 4B.12.4.1.2 **Through-penetration firestop system.** Through penetrations shall be protected by an approved through-penetration fire stop system installed and tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 2.5 Pa. The system shall have an F rating and a T rating of not less than 1 hour but not less than the required rating of the floor penetrated.  
**Exception:** Floor penetrations contained and located within the cavity of a wall do not require a T rating.

**4B.12.4.2 Membrane penetrations.** Penetrations of membranes that are part of a fire-resistance-rated horizontal assembly shall comply with Section 4B.12.4.1.1 or 4B.12.4.1.2. Where floor/ceiling assemblies are required to have a minimum 1-hour fire-resistance rating, recessed fixtures shall be installed such that the required fire resistance will not be reduced.

**Exceptions:**

1. Membrane penetrations by steel, ferrous or copper conduits, electrical outlet boxes, pipes, tubes, vents, concrete, or masonry-penetrating items where the annular space is protected either in accordance with Section 4B.12.4.1 or to prevent the free passage of flame and the products of combustion. Such penetrations shall not exceed an aggregate area of 0.0645 m<sup>2</sup> in any 9.3 m<sup>2</sup> of ceiling area in assemblies tested without penetrations.
2. Membrane penetrations by listed electrical outlet boxes of any material are permitted provided such boxes have been tested for use in fire-resistance-rated assemblies and are installed in accordance with the instructions included in the listing.
3. The annular space created by the penetration of a fire sprinkler provided it is covered by a metal escutcheon plate.

**4B.12.4.3 Nonfire-resistance-rated assemblies.** Penetrations of horizontal assemblies without a required fire-resistance rating shall meet the requirements of Section 4B.7 or shall comply with Sections 4B.12.4.3.1 through 4B.12.4.3.2.

**4B.12.4.3.1 Noncombustible penetrating items.** Noncombustible penetrating items that connect not more than three stories are permitted provided that the annular space is filled with an approved noncombustible material to resist the free passage of flame and the products of combustion.

**4B.12.4.3.2 Penetrating items.** Penetrating items that connect not more than two stories are permitted provided that the annular space is filled with an approved material to resist the free passage of flame and the products of combustion.

**4B.12.4.4 Ducts and air transfer openings.** Penetrations of horizontal assemblies by ducts and air transfer openings that are not required to have dampers shall comply with this section. Ducts and air transfer openings that are protected with dampers shall comply with Section 4B.16.

**4B.12.4.5 Dissimilar materials.** Noncombustible penetrating items shall not connect to combustible materials beyond the point of fire stopping unless it can be demonstrated that the fire-resistance integrity of the horizontal assembly is maintained.

**4B.12.4.6 Floor fire doors.** Floor fire doors used to protect openings in fire-resistance-rated floors shall be tested in the horizontal position in accordance with ASTM E 119, and shall achieve a fire-resistance rating not less than the assembly being penetrated. Floor fire doors shall be labeled by an approved agency.

## **SECTION 4B.13 FIRE-RESISTANT JOINT SYSTEMS**

**4B.13.1 General.** Joints installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies shall be protected by an approved fire-resistant joint system designed to resist the passage of fire for a time period not less than the required fire-resistance rating of the wall, floor or roof in or between which it is installed. Fire-resistant joint systems shall be tested in accordance with Section 4B.13.3. The void created at the intersection of a floor/ceiling assembly and an exterior curtain wall assembly shall be protected in accordance with Section 4B.13.4.

**Exception:** Fire-resistant joint systems shall not be required for joints in all of the following locations:

1. Floors within a single dwelling unit.
2. Floors where the joint is protected by a shaft enclosure in accordance with Section 4B.7.
3. Floors within atriums where the space adjacent to the atrium is included in the volume of the atrium for smoke control purposes.
4. Floors within malls.
5. Floors within open parking structures.
6. Mezzanine floors.
7. Walls that are permitted to have unprotected openings.
8. Roofs where openings are permitted.
9. Control joints not exceeding a maximum width of 16 mm and tested in accordance with ASTM E 119.

**4B.13.2 Installation.** Fire-resistant joint systems shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases.

**4B.13.3 Fire test criteria.** Fire-resistant joint systems shall be tested in accordance with the requirements of either ASTM E 1966 or UL 2079. Nonsymmetrical wall joint systems shall be tested with both faces exposed to the furnace, and the assigned fire-resistance rating shall be the shortest duration obtained from the two tests. When evidence is furnished to show that the wall was tested with the least fire-resistant side exposed to the furnace, subject to acceptance of the building official, the wall need not be subjected to tests from the opposite side.

**Exception:** For exterior walls with a horizontal fire separation distance greater than 1.5 m, the joint system shall be required to be tested for interior fire exposure only.

**4B.13.4 Exterior curtain wall/floor intersection.** Where fire-resistance-rated floor or floor/ceiling assemblies are required, voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies shall be sealed with an approved material or system to prevent the interior spread of fire. Such material or systems shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 2.5 Pa for the time period at least equal to the fire-resistance rating of the floor assembly. Height and fire-resistance requirements for curtain wall spandrels shall comply with Section 4B.4.9.

## SECTION 4B.14

### FIRE-RESISTANCE RATING OF STRUCTURAL MEMBERS

**4B.14.1 Requirements.** The fire-resistance rating of structural members and assemblies shall comply with the requirements for the type of construction and shall not be less than the rating required for the fire-resistance-rated assemblies supported.

**Exception:** Fire barriers and fire partitions as provided in Sections 4B.6.4 and 4B.8.4, respectively.

**4B.14.2 Protection of structural members.** Protection of columns, girders, trusses, beams, lintels or other structural members that are required to have a fire-

resistance rating shall comply with this section.

- 4B.14.2.1 Individual protection.** Columns, girders, trusses, beams, lintels or other structural members that are required to have a fire-resistance rating and that support more than two floors or one floor and roof, or support a load-bearing wall or a non load-bearing wall more than two stories high, shall be individually protected on all sides for the full length with materials having the required fire-resistance rating. Other structural members required to have a fire-resistance rating shall be protected by individual encasement, by a membrane or ceiling protection as specified in Section 4B.11, or by a combination of both. Columns shall also comply with Section 4B.14.2.2.
- 4B.14.2.2 Column protection above ceilings.** Where columns require a fire-resistance rating, the entire column, including its connections to beams or girders, shall be protected. Where the column extends through a ceiling, fire resistance of the column shall be continuous from the top of the floor through the ceiling space to the top of the column.
- 4B.14.2.3 Truss protection.** The required thickness and construction of fire-resistance-rated assemblies enclosing trusses shall be based on the results of full-scale tests or combinations of tests on truss components or on approved calculations based on such tests that satisfactorily demonstrate that the assembly has the required fire resistance.
- 4B.14.2.4 Attachments to structural members.** The edges of lugs, brackets, rivets and bolt heads attached to structural members shall be permitted to extend to within 25 mm of the surface of the fire protection.
- 4B.14.2.5 Reinforcing.** Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement except that stirrups and spiral reinforcement ties are permitted to project not more than 13 mm into the protection.
- 4B.14.3 Embedment and enclosures.** Pipes, wires, conduits, ducts or other service facilities shall not be embedded in the required fire protective covering of a structural member that is required to be individually encased.
- 4B.14.4 Impact protection.** Where the fire protective covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire protective covering shall be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than 1.5 m from the finished floor.
- 4B.14.5 Exterior structural members.** Load-bearing structural members located within the exterior walls or on the outside of a building or structure shall be provided with the highest fire-resistance rating as determined in accordance with the following:
1. As required by Table 4A.1 for the type of building element based on the type of construction of the building;
  2. As required by Table 4A.1 for exterior bearing walls based on the type of construction; and
  3. As required by Table 4A.2 for exterior walls based on the fire separation distance.
- 4B.14.6 Bottom flange protection.** Fire protection is not required at the bottom flange of lintels, shelf angles and plates, spanning not more than 1.8 m whether part of the structural frame or not, and from the bottom flange of lintels, shelf angles and plates not part of the structural frame, regardless of span.

## SECTION 4B.15 OPENING PROTECTIVES

- 4B.15.1 General.** Opening protectives required by other sections of these code requirements shall comply with the provisions of this section.
- 4B.15.2 Fire-resistance-rated glazing.** Labeled fire-resistance-rated glazing tested as part of a fire-resistance-rated wall assembly in accordance with ASTM E 119 shall not be required to comply with this section.
- 4B.15.3 Fire door and shutter assemblies.** Approved fire door and fire shutter assemblies shall be constructed of any material or assembly of component materials that conforms to the test requirements of Section 4B.15.3.1, 4B.15.3.2 or 4B.15.3.3 and the fire protection rating indicated in Table 4B.15.3. Fire door assemblies and shutters shall be installed in accordance with the provisions of this section and NFPA 80.
- Exceptions:**
1. Labeled protective assemblies that conform to the requirements of this section or UL 10A, UL 14B and UL 14C for tin-clad fire door assemblies.
  2. Floor fire doors shall comply with Section 4B.12.4.6.
- 4B.15.3.1 Side-hinged or pivoted swinging doors.** Side-hinged and pivoted swinging doors shall be tested in accordance with NFPA 252 or UL 10C. After 5 minutes into the NFPA 252 test, the neutral pressure level in the furnace shall be established at 1 m or less above the sill.
- 4B.15.3.2 Other types of doors.** Other types of doors, including swinging elevator doors, shall be tested in accordance with NFPA 252 or UL 10B. The pressure in the furnace shall be maintained as nearly equal to the atmospheric pressure as possible. Once established, the pressure shall be maintained during the entire test period.

**TABLE 4B.15.3  
FIRE DOOR AND FIRE SHUTTER FIRE PROTECTION RATINGS**

TYPE OF ASSEMBLY	REQUIRED ASSEMBLY RATING (hours)	MINIMUM FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)
Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour	4 3 2 1 ½	3 3 <sup>a</sup> 1 ½ 1 ½
Fire barriers having a required fire-resistance rating of 1 hour: Shaft exit enclosure and exit passageway walls Other fire barriers	 1 1	 1 ¾
Fire partitions: Corridor walls Other fire partitions	 1 0.5 1	 1/3 <sup>b</sup> 1/3 <sup>b</sup> ¾
Exterior walls	3 2 1	1 ½ 1 ½ ¾

- a. Two doors, each with a fire protection rating of 1 ½ hours, installed on opposite sides of the same opening in a fire wall, shall be deemed equivalent in fire protection rating to one 3-hour fire door.
- b. For testing requirements, see Section 4B.15.3.3.

**4B.15.3.3 Door assemblies in corridors and smoke barriers.** Fire door assemblies required to have a minimum fire protection rating of 20 minutes where located in corridor walls or smoke barrier walls having a fire-resistance rating in accordance with Table 4B.15.3 shall be tested in accordance with NFPA 252 or UL 10C without the hose stream test. If a 20-minute fire door assembly contains glazing material, the glazing material in the door itself shall have a minimum fire protection rating of 20 minutes and be exempt from the hose stream test. Glazing material in any other part of the door assembly, including transom lites and side lites, shall be tested in accordance with NFPA 257, including the hose stream test, in accordance with Section 4B.15.4. Fire door assemblies shall also meet the requirements for a smoke- and draft-control door assembly tested in accordance with UL 1784 with an artificial bottom seal installed across the full width of the bottom of the door assembly. The air leakage rate of the door assembly shall not exceed  $0.01524 \text{ m}^3/\text{s}/\text{m}^2$  of door opening at 25 Pa for both the ambient temperature and elevated temperature tests. Louvers shall be prohibited.

**Exceptions:**

1. View ports that require a hole not larger than 25 mm in diameter through the door, have at least a 6 mm glass disc and the holder is of metal that will not melt out where subject to temperatures of 927°C.
2. Corridor door assemblies in occupancies of Group I-2 shall be in accordance with Section 2A.7.3.1.
3. Unprotected openings shall be permitted for corridors in multi theater complexes where each motion picture auditorium has at least one-half of its required exit or exit access doorways opening directly to the exterior or into an exit passageway.

**4B.15.3.4 Doors in vertical exit enclosures and exit passageways.** Fire door assemblies in vertical exit enclosures and exit passageways shall have a maximum transmitted temperature end point of not more than 232°C above ambient at the end of 30 minutes of standard fire test exposure.

**Exception:** The maximum transmitted temperature end point is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

**4B.15.3.4.1 Glazing in doors.** Fire-protection-rated glazing in excess of  $0.065 \text{ m}^2$  shall be permitted in fire door assemblies when tested in accordance with NFPA 252 as components of the door assemblies and not as glass lights, and shall have a maximum transmitted temperature end point of 232°C in accordance with Section 4B.15.3.4.

**Exception:** The maximum transmitted temperature end point is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

**4B.15.3.5 Labeled protective assemblies.** Fire door assemblies shall be labeled by an approved agency. The labels shall comply with NFPA 80, and shall be permanently affixed to the door or frame.

**4B.15.3.5.1 Fire door labeling requirements.** Fire doors shall be labeled showing the name of the manufacturer, the name of the third-party inspection agency, the fire protection rating and, where required for fire doors in exit enclosures by Section 4B.15.3.4, the maximum transmitted temperature end point. Smoke and draft control doors complying with UL 1784 shall be labeled as such. Labels shall be approved and permanently affixed. The label shall be applied at the factory or location where fabrication and assembly are performed.

**4B.15.3.5.2 Oversized doors.** Oversized fire doors shall bear an oversized fire door label by an approved agency or shall be provided with a certificate of inspection furnished



by an approved testing agency. When a certificate of inspection is furnished by an approved testing agency, the certificate shall state that the door conforms to the requirements of design, materials and construction, but has not been subjected to the fire test.

**4B.15.3.5.3 Smoke and draft control door labeling requirements.** Smoke and draft control doors complying with UL 1784 shall be labeled in accordance with Section 4B.15.3.5.1 and shall show the letter “S” on the fire rating label of the door. This marking shall indicate that the door and frame assembly are in compliance when listed or labeled gasketing is also installed.

**4B.15.3.5.4 Fire door frame labeling requirements.** Fire door frames shall be labeled showing the names of the manufacturer and the third-party inspection agency.

**4B.15.3.6 Glazing material.** Fire-protection-rated glazing conforming to the opening protection requirements in Section 4B.15.3 shall be permitted in fire door assemblies.

**4B.15.3.6.1 Size limitations.** Wired glass used in fire doors shall comply with Table 4B.15.4.3. Other fire-protection-rated glazing shall comply with the size limitations of NFPA 80.

**Exceptions:**

1. Fire-protection-rated glazing in fire doors located in fire walls shall be prohibited except that where serving as a horizontal exit, a self-closing swinging door shall be permitted to have a vision panel of not more than 0.0645 m<sup>2</sup> without a dimension exceeding 250 mm.
2. Fire-protection-rated glazing shall not be installed in fire doors having a 1 ½ - hour fire protection rating intended for installation in fire barriers, unless the glazing is not more than 0.0645 m<sup>2</sup> in area.

**4B.15.3.6.2 Exit and elevator protectives.** Approved fire-protection-rated glazing used in fire doors in elevator and stairway shaft enclosures shall be so located as to furnish clear vision of the passageway or approach to the elevator or stairway.

**4B.15.3.6.3 Labeling.** Fire-protection-rated glazing shall bear a label or other identification showing the name of the manufacturer, the test standard and the fire protection rating. Such label or other identification shall be issued by an approved agency and shall be permanently affixed.

**4B.15.3.6.4 Safety glazing.** Fire-protection-rated glazing installed in fire doors or fire window assemblies in areas subject to human impact in hazardous locations shall comply with Chapter 11 of the SBC 201.

**4B.15.3.7 Door closing.** Fire doors shall be self-closing or automatic-closing in accordance with this section.

**Exception:** Fire doors located in common walls separating sleeping units in Group R-1 shall be permitted without automatic-closing or self-closing devices.

**4B.15.3.7.1 Latch required.** Unless otherwise specifically permitted, single fire doors and both leaves of pairs of side-hinged swinging fire doors shall be provided with an active latch bolt that will secure the door when it is closed.

**4B.15.3.7.2 Automatic-closing fire door assemblies.** Automatic-closing fire door assemblies shall be self-closing in accordance with NFPA 80.

**4B.15.3.7.3 Smoke-activated doors.** Automatic-closing fire doors installed in the following locations shall be automatic-closing by the actuation of smoke detectors installed in accordance with Section 7.7.10 or by loss of power to the smoke detector or hold-open device. Fire doors that are automatic-closing by smoke detection shall not have more than a 10-second delay before the door starts to close after the smoke detector is actuated.

1. Doors installed across a corridor.
2. Doors that protect openings in horizontal exits, exits or exit access corridors

required to be of fire-resistance-rated construction.

3. Doors that protect openings in walls required to be fire-resistance rated by Table 2A.2.1.1.
4. Doors installed in smoke barriers in accordance with Section 4B.9.5.
5. Doors installed in fire partitions in accordance with Section 4B.8.6.
6. Doors installed in a fire wall in accordance with Section 4B.5.8.

**4B.15.3.7.4 Doors in pedestrian ways.** Vertical sliding or vertical rolling steel fire doors in openings through which pedestrians travel shall be heat activated or activated by smoke detectors with alarm verification.

**4B.15.3.8 Swinging fire shutters.** Where fire shutters of the swinging type are installed in exterior openings, not less than one row in every three vertical rows shall be arranged to be readily opened from the outside, and shall be identified by distinguishing marks or letters not less 150 mm high.

**4B.15.3.9 Rolling fire shutters.** Where fire shutters of the rolling type are installed, such shutters shall include approved automatic-closing devices.

**4B.15.4 Fire-protection rated glazing.** Glazing in fire window assemblies shall be fire protection rated in accordance with this section and Table 4B.15.4. Glazing in fire doors shall comply with Section 4B.15.3.6. Fire-protection-rated glazing installed as an opening protective in fire partitions, smoke barriers and fire barriers shall be tested in accordance with and shall meet the acceptance criteria of NFPA 257 for a fire protection rating of 45 minutes. Fire-protection-rated glazing shall also comply with NFPA 80. Fire-protection-rated glazing required in accordance with Section 4B.4.12 for exterior wall opening protection shall be tested in accordance with and shall meet the acceptance criteria of NFPA 257 for a fire protection rating as required in Section 4B.15.4.7.

**Exceptions:**

1. Wired glass in accordance with Section 4B.15.4.3.
2. Fire-protection-rated glazing in 0.5-hour fire-resistance-rated partitions is permitted to have an 0.33-hour fire protection rating.

**4B.15.4.1 Testing under positive pressure.** NFPA 257 shall evaluate fire-protection-rated glazing under positive pressure. Within the first 10 minutes of a test, the pressure in the furnace shall be adjusted so at least two-thirds of the test specimen is above the neutral pressure plane, and the neutral pressure plane shall be maintained at that height for the balance of the test.

**4B.15.4.2 Nonsymmetrical glazing systems.** Nonsymmetrical fire-protection-rated glazing systems in fire partitions, fire barriers or in exterior walls with a fire separation of 1.5 m or less pursuant to Section 4B.4 shall be tested with both faces exposed to the furnace, and the assigned fire protection rating shall be the shortest duration obtained from the two tests conducted in compliance with NFPA 257.

**TABLE 4B.15.4  
FIRE WINDOW ASSEMBLY FIRE PROTECTION RATINGS**

TYPE OF ASSEMBLY	REQUIRED ASSEMBLY RATING (hours)	MINIMUM FIRE WINDOW ASSEMBLY RATING (hours)
Interior walls:		
Fire walls	All	NP <sup>a</sup>
Fire barriers and fire partitions	> 1	NP <sup>a</sup>
	1	<sup>3</sup> / <sub>4</sub>
Smoke barriers	1	<sup>3</sup> / <sub>4</sub>
Exterior walls	> 1	1 <sup>1</sup> / <sub>2</sub>
	1	<sup>3</sup> / <sub>4</sub>
Party walls	All	NP <sup>a</sup>

a. Not permitted except as specified in Section 4B.15.2.

**4B.15.4.3 Wired glass.** Steel window frame assemblies of 3 mm minimum solid section or of not less than nominal 1-mm-thick formed sheet steel members fabricated by pressing, mitering, riveting, interlocking or welding and having provision for glazing with 6 mm wired glass where securely installed in the building construction and glazed with 6 mm labeled wired glass shall be deemed to meet the requirements for a 3/4-hour fire window assembly. Wired glass panels shall conform to the size limitations set forth in Table 4B.15.4.3.

**TABLE 4B.15.4.3  
LIMITING SIZES OF WIRED GLASS PANELS**

<b>OPENING FIRE PROTECTION RATING</b>	<b>MAXIMUM AREA (square mm)</b>	<b>MAXIMUM HEIGHT (mm)</b>	<b>MAXIMUM WIDTH (mm)</b>
3 hours	0	0	0
1 ½ hour doors in exterior walls	0	0	0
1 and 1 ½ hours	64,500	835	250
¾ hours	836,180	1,370	1,370
20 minutes	Not Limited	Not Limited	Not Limited
Fire window assemblies	836,180	1,370	1,370

**4B.15.4.4 Nonwired glass.** Glazing other than wired glass in fire window assemblies shall be fire-protection-rated glazing installed in accordance with and complying with the size limitations set forth in NFPA 80.

**4B.15.4.5 Installation.** Fire-protection-rated glazing shall be in the fixed position or be automatic-closing and shall be installed in approved frames.

**4B.15.4.6 Window mullions.** Metal mullions that exceed a nominal height of 3.7 m shall be protected with materials to afford the same fire-resistance rating as required for the wall construction in which the protective is located.

**4B.15.4.7 Interior fire window assemblies.** Fire-protection-rated glazing used in fire window assemblies located in fire partitions and fire barriers shall be limited to use in assemblies with a maximum fire-resistance rating of 1 hour in accordance with this section.

**4B.15.4.7.1 Where permitted.** Fire-protection-rated glazing shall be limited to fire partitions designed in accordance with Section 4B.8 and fire barriers utilized in the applications set forth in Sections 4B.6.3.5 and 4B.6.3.6 where the fire-resistance rating does not exceed 1 hour.

**4B.15.4.7.2 Size limitations.** The total area of windows shall not exceed 25 percent of the area of a common wall with any room.

**4B.15.4.8 Exterior fire window assemblies.** Exterior openings, other than doors, required to be protected by Section 4B.4.12, where located in a wall required by Table 4A.2 to have a fire-resistance rating of greater than 1 hour, shall be protected with an assembly having a fire protection rating of not less than 1 ½ hours. Exterior openings required to be protected by Section 4B.4.8, where located in a wall required by Table 4A.2 to have a fire-resistance rating of 1 hour, shall be protected with an assembly having a fire protection rating of not less than ¾ hour. Exterior openings required to be protected by Section 4B.4.9 or 4B.4.10 shall be protected with an assembly having a fire protection rating of not less than ¾ hour. Openings in non fire-resistance-rated exterior wall assemblies that require protection in accordance with Section 4B.4.8, 4B.4.9 or 4B.4.10 shall have a fire protection rating of not less than ¾ hour.

- 4B.15.4.9 Labeling requirements.** Fire-protection-rated glazing shall bear a label or other identification showing the name of the manufacturer, the test standard, and the fire protection rating. Such label or identification shall be issued by an approved agency and shall be permanently affixed.

## SECTION 4B.16 DUCTS AND AIR TRANSFER OPENINGS

- 4B.16.1 General.** The provisions of this section shall govern the protection of ducts and air transfer openings in fire-resistance-rated assemblies.
- 4B.16.1.1 Ducts and air transfer openings without dampers.** Ducts and air transfer openings that penetrate fire-resistance-rated assemblies and are not required by this section to have dampers shall comply with the requirements of Section 4B.12.
- 4B.16.2 Installation.** Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling dampers located within air distribution and smoke control systems shall be installed in accordance with the requirements of this section, the manufacturer's installation instructions and listing.
- 4B.16.2.1 Smoke control system.** Where the installation of a fire damper will interfere with the operation of a required smoke control system in accordance with Section 7.9, approved alternative protection shall be utilized.
- 4B.16.2.2 Hazardous exhaust ducts.** Fire dampers for hazardous exhaust duct systems shall comply with the SBC 501.
- 4B.16.3 Damper testing and ratings.** Dampers shall be listed and bear the label of an approved testing agency indicating compliance with the standards in this section. Fire dampers shall comply with the requirements of UL 555. Only fire dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire. Smoke dampers shall comply with the requirements of UL 555S. Combination fire/smoke dampers shall comply with the requirements of both UL 555 and UL 555S. Ceiling radiation dampers shall comply with the requirements of UL 555C.
- 4B.16.3.1 Fire protection rating.** Fire dampers shall have the minimum fire protection rating specified in Table 4B.16.3.1 for the type of penetration.

**TABLE 4B.16.3.1  
FIRE DAMPER RATING**

TYPE OF PENETRATION	MINIMUM DAMPER RATING (hour)
Less than 3-hour fire resistance-rated assemblies	1.5
3-hour or greater fire resistance-rated assemblies	3

- 4B.16.3.1.1 Fire damper actuating device.** The fire damper actuating device shall meet one of the following requirements:
1. The operating temperature shall be approximately 10°C above the normal temperature within the duct system, but not less than 70°C.
  2. The operating temperature shall be not more than 140°C where located in a smoke control system complying with Section 7.9.
  3. Where a combination fire/smoke damper is located in a smoke control system complying with Section 7.9, the operating temperature rating shall be approximately 10°C above the maximum smoke control system designed operating temperature, or a maximum temperature of 177°C. The temperature

shall not exceed the UL 555S degradation test temperature rating for a combination fire/smoke damper.

**4B.16.3.2 Smoke damper ratings.** Smoke damper leakage ratings shall not be less than Class II. Elevated temperature ratings shall not be less than 120°C.

**4B.16.3.2.1 Smoke damper actuation methods.** The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with Section 7.7.10 and one of the following methods, as applicable:

1. Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 1.5 m of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed. Other than in mechanical smoke control systems, dampers shall be closed upon fan shutdown where local smoke detectors require a minimum velocity to operate.
2. Where a damper is installed above smoke barrier doors in a smoke barrier, a spot-type detector listed for releasing service shall be installed on either side of the smoke barrier door opening.
3. Where a damper is installed within an unducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 1.5 m horizontally of the damper.
4. Where a damper is installed in a corridor wall, the damper shall be permitted to be controlled by a smoke detection system installed in the corridor.
5. Where a total-coverage smoke detector system is provided within areas served by a heating, ventilation and air-conditioning (HVAC) system, dampers shall be permitted to be controlled by the smoke detection system.

**4B.16.4 Access and identification.** Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. The access shall not affect the integrity of fire-resistance-rated assemblies. The access openings shall not reduce the fire-resistance rating of the assembly. Access points shall be permanently identified on the exterior by a label having letters not less than 13 mm in height reading: SMOKE DAMPER or FIRE DAMPER. Access doors in ducts shall be tight fitting and suitable for the required duct construction.

**4B.16.5 Where required.** Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers shall be provided at the locations prescribed in this section. Where an assembly is required to have both fire dampers and smoke dampers, combination fire/smoke dampers or a fire damper and a smoke damper shall be required.

**4B.16.5.1 Fire walls.** Ducts and air transfer openings permitted in fire walls in accordance with Section 4B.5.11 shall be protected with approved fire dampers installed in accordance with their listing.

**4B.16.5.2 Fire barriers.** Duct and air transfer openings of fire barriers shall be protected with approved fire dampers installed in accordance with their listing.

**Exception:** Fire dampers are not required at penetrations of fire barriers where any of the following apply:

1. Penetrations are tested in accordance with ASTM E119 as part of the fire-resistance-rated assembly.
2. Ducts are used as part of an approved smoke control system in accordance with Section 7.9.
3. Such walls are penetrated by ducted HVAC systems, have a required fire-resistance rating of 1 hour or less, are in areas of other than Group H and are in

buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2. For the purposes of this exception, a ducted HVAC system shall be a duct system for conveying supply, return or exhaust air as part of the structure's HVAC system. Such a duct system shall be constructed of sheet steel not less than 0.5 mm (26 gage) thickness and shall be continuous from the air-handling appliance or equipment to the air outlet and inlet terminals.

**4B.16.5.3 Shaft enclosures.** Ducts and air transfer openings shall not penetrate a shaft serving as an exit enclosure except as permitted by Section 8.20.5.

**4B.16.5.3.1 Penetrations of shaft enclosures.** Shaft enclosures that are permitted to be penetrated by ducts and air transfer openings shall be protected with approved fire and smoke dampers installed in accordance with their listing.

**Exceptions:**

1. Fire dampers are not required at penetrations of shafts where:
  - 1.1 Steel exhaust subducts extended at least 560 mm vertically in exhaust shafts provided there is a continuous airflow upward to the outside, or
  - 1.2 Penetrations are tested in accordance with ASTM E 119 as part of the rated assembly, or
  - 1.3 Ducts are used as part of an approved smoke control system designed and installed in accordance with Section 7.9, and where the fire damper will interfere with the operation of the smoke control system, or
  - 1.4 The penetrations are in parking garage exhaust or supply shafts that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.
2. In Group B occupancies, equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, smoke dampers are not required at penetrations of shafts where:
  - 2.1 Bathroom and toilet room exhaust openings with steel exhaust subducts, having a wall thickness of at least 0.5 mm that extend at least 560 mm vertically and the exhaust fan at the upper terminus, powered continuously in accordance with the provisions of Section 7.9.11, maintains airflow upward to the outside, or
  - 2.2 Ducts are used as part of an approved smoke control system, designed and installed in accordance with Section 7.9, and where the smoke damper will interfere with the operation of the smoke control system, or
3. Smoke dampers are not required at penetration of exhaust or supply shafts in parking garages that are separated from other building shafts by not less than 2-hour fire-resistance-rated construction.

**4B.16.5.4 Fire partitions.** Duct penetrations in fire partitions shall be protected with approved fire dampers installed in accordance with their listing.

**Exceptions:** In occupancies other than Group H, fire dampers are not required where any of the following apply:

1. The partitions are tenant separation and corridor walls in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 and the duct is protected as a through penetration in accordance with Section 4B.12.
2. The duct system is constructed of approved materials in accordance with the SBC 501 and the duct penetrating the wall meets all of the following minimum requirements:
  - 2.1 The duct shall not exceed 0.065 m<sup>2</sup>.
  - 2.2 The duct shall be constructed of steel a minimum 0.55 mm in thickness.
  - 2.3 The duct shall not have openings that communicate the corridor with

adjacent spaces or rooms.

- 2.4 The duct shall be installed above a ceiling.
- 2.5 The duct shall not terminate at a wall register in the fire-resistance-rated wall.
- 2.6 A minimum 300 mm long by 1.5 mm thick steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 38 mm by 38 mm by 1.5 mm steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 (M5) screws. The annular space between the steel sleeve and wall opening shall be filled with rock (mineral) wool batting on all sides.

**4B.16.5.4.1 Corridors.** A listed smoke damper designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a corridor enclosure required to have smoke and draft control doors in accordance with Section 4B.15.3.3.

**Exceptions:**

1. Smoke dampers are not required where the building is equipped throughout with an approved smoke control system in accordance with Section 7.9, and smoke dampers are not necessary for the operation and control of the system.
2. Smoke dampers are not required in corridor penetrations where the duct is constructed of steel not less than 0.5 mm in thickness and there are no openings serving the corridor.

**4B.16.5.5 Smoke barriers.** A listed smoke damper designed to resist the passage of smoke shall be provided at each point a duct or air transfer opening penetrates a smoke barrier. Smoke dampers and smoke damper actuation methods shall comply with Section 4B.16.3.2.1.

**Exception:** Smoke dampers are not required where the openings in ducts are limited to a single smoke compartment and the ducts are constructed of steel.

**4B.16.6 Horizontal assemblies.** Penetrations by ducts and air transfer openings of a floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly shall be protected by a shaft enclosure that complies with Section 4B.7 or shall comply with this section.

**4B.16.6.1 Through penetrations.** In occupancies other than Groups I-2 and I-3, a duct and air transfer opening system constructed of approved materials in accordance with the SBC 501 that penetrates a fire-resistance-rated floor/ceiling assembly that connects not more than two stories is permitted without shaft enclosure protection provided a fire damper is installed at the floor line.

**Exception:** A duct is permitted to penetrate three floors or less without a fire damper at each floor provided it meets all of the following requirements.

1. The duct shall be contained and located within the cavity of a wall and shall be constructed of steel not less 0.5 mm in thickness.
2. The duct shall open into only one dwelling unit or sleeping unit and the duct system shall be continuous from the unit to the exterior of the building.
3. The duct shall not exceed 100 mm nominal diameter and the total area of such ducts shall not exceed 0.0645 m<sup>2</sup> for any 9.3 m<sup>2</sup> of floor area.
4. The annular space around the duct is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature conditions under a minimum positive pressure differential of 2.5 Pa at the location of the penetration for the time period equivalent to the fire-resistance rating of the construction penetrated.

5. Grille openings located in a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly shall be protected with a ceiling radiation damper in accordance with Section 4B.16.6.2.

**4B.16.6.2 Membrane penetrations.** Where duct systems constructed of approved materials in accordance with the SBC 501 penetrate a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly, shaft enclosure protection is not required provided an approved ceiling radiation damper is installed at the ceiling line. Where a duct is not attached to a diffuser that penetrates a ceiling of a fire-resistance-rated floor/ceiling or roof/ceiling assembly, shaft enclosure protection is not required provided an approved ceiling radiation damper is installed at the ceiling line. Ceiling radiation dampers shall be tested in accordance with UL 555C and constructed in accordance with the details listed in a fire-resistance-rated assembly or shall be labeled to function as a heat barrier for air-handling outlet/inlet penetrations in the ceiling of a fire-resistance-rated assembly. Ceiling radiation dampers shall not be required where ASTM E 119 fire tests have shown that ceiling radiation dampers are not necessary in order to maintain the fire-resistance rating of the assembly. Ceiling radiation dampers shall not be required where exhaust duct penetrations are protected in accordance with Section 4B.12.4.2 and the exhaust ducts are located within the cavity of a wall, and do not pass through another dwelling unit or tenant space.

**4B.16.6.3 Nonfire-resistance-rated assemblies.** Duct systems constructed of approved materials in accordance with the SBC 501 that penetrate nonfire-resistance-rated floor assemblies and that connect not more than two stories are permitted without shaft enclosure protection provided that the annular space between the assembly and the penetrating duct is filled with an approved noncombustible material to resist the free passage of flame and the products of combustion. Duct systems constructed of approved materials in accordance with the SBC 501 that penetrate nonfire-resistance-rated floor assemblies and that connect not more than three stories are permitted without shaft enclosure protection provided that the annular space between the assembly and the penetrating duct is filled with an approved noncombustible material to resist the free passage of flame and the products of combustion, and a fire damper is installed at each floor line.

**Exception:** Fire dampers are not required in ducts within individual residential dwelling units.

**4B.16.7 Flexible ducts and air connectors.** Flexible ducts and air connectors shall not pass through any fire-resistance-rated assembly. Flexible air connectors shall not pass through any wall, floor or ceiling.

## SECTION 4B.17 CONCEALED SPACES

**4B.17.1 General.** Fire blocking and draft stopping shall be installed in combustible concealed locations in accordance with this section. Fire blocking shall comply with Section 4B.17.2. Draft stopping in floor/ceiling spaces and attic spaces shall comply with Sections 4B.17.3 and 4B.17.4, respectively. The permitted use of combustible materials in concealed spaces of noncombustible buildings shall be limited to the applications indicated in Section 4B.17.5.

**4B.17.2 Fire blocking.** In combustible construction, fire blocking shall be installed to cut off concealed draft openings (both vertical and horizontal) and shall form an effective barrier between floors, between a top story and a roof or attic space. Fire



blocking shall be installed in the locations specified in Sections 4B.17.2.2 through 4B.17.2.7.

- 4B.17.2.1 Fire blocking materials.** Fire blocking shall consist of 50 mm nominal lumber or two thicknesses of 25 mm nominal lumber with broken lap joints or one thickness of 18 mm wood structural panel with joints backed by 18 mm wood structural panel or one thickness of 20 mm particleboard with joints backed by 20 mm particleboard. Gypsum board, cement fiber board, batts or blankets of mineral wool or glass fiber or other approved materials installed in such a manner as to be securely retained in place shall be permitted as an acceptable fire block. Batts or blankets of mineral or glass fiber or other approved non-rigid materials shall be permitted for compliance with the 3000 mm horizontal fire blocking in walls constructed using parallel rows of studs or staggered studs. Loose-fill insulation material shall not be used as a fire block unless specifically tested in the form and manner intended for use to demonstrate its ability to remain in place and to retard the spread of fire and hot gases. The integrity of fire blocks shall be maintained.
- 4B.17.2.1.1 Double stud walls.** Batts or blankets of mineral or glass fiber or other approved non-rigid materials shall be allowed as fire blocking in walls constructed using parallel rows of studs or staggered studs.
- 4B.17.2.2 Concealed wall spaces.** Fire blocking shall be provided in concealed spaces of stud walls and partitions, including furred spaces, and parallel rows of studs or staggered studs, as follows:
- a. Vertically at the ceiling and floor levels.
  - b. Horizontally at intervals not exceeding 3 m.
- 4B.17.2.3 Connections between horizontal and vertical spaces.** Fire blocking shall be provided at interconnections between concealed vertical stud wall or partition spaces and concealed horizontal spaces created by an assembly of floor joists or trusses, and between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings and similar locations.
- 4B.17.2.4 Stairways.** Fire blocking shall be provided in concealed spaces between stair stringers at the top and bottom of the run. Enclosed spaces under stairs shall also comply with Section 8.19.1.5.
- 4B.17.2.5 Ceiling and floor openings.** Where annular space protection is provided in accordance with Exception 6 of Section 4B.7.2, Exception 1 of Section 4B.12.4.2, or Section 4B.12.4.3, fire blocking shall be installed at openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels, with an approved material to resist the free passage of flame and the products of combustion. Factory-built chimneys and fireplaces shall be fire blocked in accordance with UL 103 and UL 127.
- 4B.17.2.6 Architectural trim.** Fire blocking shall be installed within concealed spaces of exterior wall finish and other exterior architectural elements where permitted to be of combustible construction in Section 9.6 of the SBC 201 or where erected with combustible frames, at maximum intervals of 6 m. If non-continuous, such elements shall have closed ends, with at least 100 mm of separation between sections.

**Exceptions:**

1. Fire blocking of cornices is not required in single-family dwellings, as applicable in SBC 201. Fire blocking of cornices of a two-family dwelling as applicable in SBC 201 is required only at the line of dwelling unit separation.
2. Fire blocking shall not be required where installed on noncombustible framing and the face of the exterior wall finish exposed to the concealed space is covered by one of the following materials:
  - 2.1 Aluminum having a minimum thickness of 0.5 mm.

2.2 Corrosion-resistant steel having a base metal thickness not less than 0.4 mm at any point.

2.3 Other approved noncombustible materials.

**4B.17.2.7 Concealed sleeper spaces.** Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistance-rated floors, the space between the floor slab and the underside of the wood flooring shall be filled with an approved material to resist the free passage of flame and products of combustion or fire blocked in such a manner that there will be no open spaces under the flooring that will exceed 9.3 m<sup>2</sup> in area and such space shall be filled solidly under permanent partitions so that there is no communication under the flooring between adjoining rooms.

**Exceptions:**

1. Fire blocking is not required for slab-on-grade floors in gymnasiums.
2. Fire blocking is required only at the juncture of each alternate lane and at the ends of each lane in a bowling facility.

**4B.17.3 Draft stopping in floors.** In combustible construction, draft stopping shall be installed to subdivide floor/ceiling assemblies in the locations prescribed in Sections 4B.17.3.2 through 4B.17.3.3.

**4B.17.3.1 Draft stopping materials.** Draft stopping materials shall not be less than 13 mm gypsum board, 10 mm wood structural panel, 10 mm particleboard or other approved materials adequately supported. The integrity of draft stops shall be maintained.

**4B.17.3.2 Groups R-1, R-2, R-3 and R-4.** Draft stopping shall be provided in floor/ceiling spaces in Group R-1 buildings, in Group R-2 buildings as applicable in SBC 201 with three or more dwelling units, in Group R-3 buildings as applicable in SBC 201 with two dwelling units and in Group R-4 buildings. Draft stopping shall be located above and in line with the dwelling unit and sleeping unit separations.

**Exceptions:**

1. Draft stopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
2. Draft stopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.2, provided that automatic sprinklers are also installed in the combustible concealed spaces.

**4B.17.3.3 Other groups.** In other groups, draft stopping shall be installed so that horizontal floor areas do not exceed 93 m<sup>2</sup>.

**Exception:** Draft stopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

**4B.17.4 Draft stopping in attics.** In combustible construction, draft stopping shall be installed to subdivide attic spaces and concealed roof spaces in the locations prescribed in Sections 4B.17.4.2 and 4B.17.4.3. Ventilation of concealed roof spaces shall be maintained in accordance with Section 7.3.2 of the SBC 201.

**4B.17.4.1 Draft stopping materials.** Materials utilized for draft stopping of attic spaces shall comply with Section 4B.17.3.1.

**4B.17.4.1.1 Openings.** Openings in the partitions shall be protected by self-closing doors with automatic latches constructed as required for the partitions.

**4B.17.4.2 Groups R-1 and R-2.** Draft stopping shall be provided in attics, mansards, overhangs or other concealed roof spaces of Group R-2 buildings with three or more dwelling units and in all Group R-1 buildings. Draft stopping shall be installed above, and in line with, sleeping unit and dwelling unit separation walls that do not extend to the underside of the roof sheathing above.

**Exceptions:**

1. Where corridor walls provide a sleeping unit or dwelling unit separation, Draft stopping shall only be required above one of the corridor walls.
2. Draft stopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.
3. In occupancies in Group R-2 that do not exceed four stories in height, the attic space shall be subdivided by draft stops into areas not exceeding 279 m<sup>2</sup> or above every two dwelling units, whichever is smaller.
4. Draft stopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.2, provided that automatic sprinklers are also installed in the combustible concealed spaces.

**4B.17.4.3 Other groups.** Draft stopping shall be installed in attics and concealed roof spaces, such that any horizontal area does not exceed 279 m<sup>2</sup>.

**Exception:** Draft stopping is not required in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

**4B.17.5 Combustibles in concealed spaces in Type I or II construction.** Combustibles shall not be permitted in concealed spaces of buildings of Type I or II construction.

**Exceptions:**

1. Combustible materials in accordance with Section 4A.3.
2. Combustible materials complying with Section 4A.2 of the SBC 501.
3. Class A interior finish materials.
4. Combustible piping within partitions or enclosed shafts installed in accordance with the provisions of these code requirements. Combustible piping shall be permitted within concealed ceiling spaces where installed in accordance with the SBC 501 and the SBC 701.

## **SECTION 4B.18**

### **FIRE-RESISTANCE REQUIREMENTS FOR PLASTER**

**4B.18.1 Thickness of plaster.** The minimum thickness of gypsum plaster or Portland cement plaster used in a fire-resistance-rated system shall be determined by the prescribed fire tests. The plaster thickness shall be measured from the face of the lath where applied to gypsum lath or metal lath.

**4B.18.2 Plaster equivalents.** For fire-resistance purposes, 13 mm of unsanded gypsum plaster shall be deemed equivalent to 20 mm of one-to-three gypsum sand plaster or 25 mm of Portland cement sand plaster.

**4B.18.3 Noncombustible furring.** In buildings of Type I and II construction, plaster shall be applied directly on concrete or masonry or on approved noncombustible plastering base and furring.

**4B.18.4 Double reinforcement.** Plaster protection more than 25 mm in thickness shall be reinforced with an additional layer of approved lath embedded at least 20 mm from the outer surface and fixed securely in place.

**Exception:** Solid plaster partitions or where otherwise determined by fire tests.

**4B.18.5 Plaster alternatives for concrete.** In reinforced concrete construction for nonstructural considerations, gypsum plaster or Portland cement plaster is permitted to be substituted for 13 mm of the required poured concrete protection, except that a minimum thickness of 10 mm of poured concrete shall be provided in

reinforced concrete floors and 25 mm in reinforced concrete columns in addition to the plaster finish. However, for structural considerations, reinforced concrete shall be in accordance with SBC 304.

## SECTION 4B.19 THERMAL- AND SOUND-INSULATING MATERIALS

- 4B.19.1 General.** Insulating materials, including facings such as vapor retarders and vapor-permeable membranes, similar coverings, and all layers of single and multilayer reflective foil insulations, shall comply with the requirements of this section. Where a flame spread index or a smoke-developed index is specified in this section, such index shall be determined in accordance with ASTM E 84. Any material that is subject to an increase in flame spread index or smoke-developed index beyond the limits herein established through the effects of age, moisture, or other atmospheric conditions shall not be permitted.
- Exceptions:**
1. Fiberboard insulation shall comply with an approved method.
  2. Foam plastic insulation shall comply with Chapter 11 of the SBC 201.
  3. Duct and pipe insulation and duct and pipe coverings and linings in plenums shall comply with the SBC 501.
- 4B.19.2 Concealed installation.** Insulating materials, where concealed as installed in buildings of any type of construction, shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 450.
- Exception:** Cellulose loose-fill insulation that is not spray applied, complying with the requirements of Section 4B.19.6, shall only be required to meet the smoke-developed index of not more than 450.
- 4B.19.2.1 Facings.** Where such materials are installed in concealed spaces in buildings of Type III, IV or V construction, the flame spread and smoke-developed limitations do not apply to facings, coverings, and layers of reflective foil insulation that are installed behind and in substantial contact with the unexposed surface of the ceiling, wall or floor finish.
- 4B.19.3 Exposed installation.** Insulating materials, where exposed as installed in buildings of any type of construction, shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 450.
- Exception:** Cellulose loose-fill insulation that is not spray applied complying with the requirements of Section 4B.19.6 shall only be required to meet the smoke-developed index of not more than 450.
- 4B.19.3.1 Attic floors.** Exposed insulation materials installed on attic floors shall have a critical radiant flux of not less than 0.12 watt per square centimeter when tested in accordance with ASTM E 970.
- 4B.19.4 Loose-fill insulation.** Loose-fill insulation materials that cannot be mounted in the ASTM E 84 apparatus without a screen or artificial supports shall comply with the flame spread and smoke-developed limits of Sections 4B.19.2 and 4B.19.3 when tested in accordance with CAN/ULC S102.2.
- Exception:** Cellulose loose-fill insulation shall not be required to comply with this test method, provided such insulation complies with the requirements of Section 4B.19.6.
- 4B.19.5 Roof insulation.** The use of combustible roof insulation not complying with Sections 4B.19.2 and 4B.19.3 shall be permitted in any type of construction

provided it is covered with approved roof coverings directly applied thereto.

- 4B.19.6 Cellulose loose-fill insulation.** Cellulose loose-fill insulation shall comply with CPSC 16 CFR, Part 1209 and CPSC 16 CFR, Part 1404. Each package of such insulating material shall be clearly labeled in accordance with CPSC 16 CFR, Part 1209 and CPSC 16 CFR, Part 1404.
- 4B.19.7 Insulation and covering on pipe and tubing.** Insulation and covering on pipe and tubing shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 450.

## SECTION 4B.20 PRESCRIPTIVE FIRE RESISTANCE

- 4B.20.1 General.** The provisions of this section contain prescriptive details of fire-resistance-rated building elements. Examples of materials of construction and assemblies listed in Table 4B.20.1(1) for structural parts, Table 4B.20.1(2) for walls and partitions and Table 4B.20.1(3) for floor and roof systems shall be assumed to have the fire-resistance ratings prescribed therein. These tables should be extended to include the materials and assemblies available locally in the Kingdom of Saudi Arabia. Where materials that change the capacity for heat dissipation are incorporated into a fire-resistance-rated assembly, fire test results or other substantiating data shall be made available to the building official to show that the required fire-resistance-rating time period is not reduced.
- 4B.20.1.1 Thickness of protective coverings.** The thickness of fire-resistant materials required for protection of structural members shall be not less than set forth in Table 4B.20.1(1), except as modified in this section. The figures shown shall be the net thickness of the protecting materials and shall not include any hollow space in back of the protection.
- 4B.20.1.2 Unit masonry protection of steel columns.** Where required, metal ties shall be embedded in transverse joints of unit masonry for protection of steel columns. Such ties shall be as set forth in Table 4B.20.1(1) or be equivalent thereto.
- 4B.20.1.3 Reinforcement for cast-in-place concrete protection for steel columns.** Cast-in-place concrete protection for steel columns shall be reinforced at the edges of such members with wire ties of not less than 5 mm in diameter wound spirally around the columns on a pitch of not more than 200 mm or by equivalent reinforcement.
- 4B.20.1.4 Plaster application.** The finish coat is not required for plaster protective coatings where they comply with the design mix and thickness requirements of Tables 4B.20.1(1), 4B.20.1(2) and 4B.20.1(3).
- 4B.20.1.5 Bonded prestressed concrete tendons.** For members having a single tendon or more than one tendon installed with equal concrete cover measured from the nearest surface, the cover shall not be less than that set forth in Table 4B.20.1(1). For members having multiple tendons installed with variable concrete cover, the average tendon cover shall not be less than that set forth in Table 4B.20.1(1), provided:
1. The clearance from each tendon to the nearest exposed surface is used to determine the average cover.
  2. In no case can the clear cover for individual tendons be less than one-half of that set forth in Table 4B.20.1(1). A minimum cover of 20 mm for slabs and 25 mm for beams is required for any aggregate concrete.
  3. For the purpose of establishing a fire-resistance rating, tendons having a clear covering less than that set forth in Table 4B.20.1(1) shall not contribute more

than 50 percent of the required ultimate moment capacity for members less than  $0.226 \text{ m}^2$  in cross-sectional area and 65 percent for larger members. For structural design purposes, however, tendons having a reduced cover are assumed to be fully effective.

## SECTION 4B.21 CALCULATED FIRE RESISTANCE

**4B.21.1 General.** The provisions of this section contain procedures by which the fire resistance of specific materials or combinations of materials is established by calculations. These procedures apply only to the information contained in this section and shall not be otherwise used. The calculated fire resistance of concrete, concrete masonry and clay masonry assemblies shall be permitted in accordance with ACI 216.1/TMS 0216.1. The calculated fire resistance of steel assemblies shall be permitted in accordance with Chapter 5 of ASCE/SFPE 29.

**4B.21.1.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**CERAMIC FIBER BLANKET.** A mineral wool insulation material made of alumina-silica fibers and weighing  $64$  to  $160 \text{ kg/m}^3$ .

**CONCRETE, CARBONATE AGGREGATE.** Concrete made with aggregates consisting mainly of calcium or magnesium carbonate, such as limestone or dolomite, and containing 40 percent or less quartz, chert, or flint.

**CONCRETE, CELLULAR.** A lightweight insulating concrete made by mixing a preformed foam with Portland cement slurry and having a dry unit weight of approximately  $480 \text{ kg/m}^3$ .

**CONCRETE, LIGHTWEIGHT AGGREGATE.** Concrete made with aggregates of expanded clay, shale, slag or slate or sintered fly ash or any natural lightweight aggregate meeting ASTM C 330 and possessing equivalent fire-resistance properties and weighing  $1,360$  to  $1,840 \text{ kg/m}^3$ .

**CONCRETE, PERLITE.** A lightweight insulating concrete having a dry unit weight of approximately  $480 \text{ kg/m}^3$  made with perlite concrete aggregate. Perlite aggregate is produced from a volcanic rock which, when heated, expands to form a glass-like material of cellular structure.

**CONCRETE, SAND-LIGHTWEIGHT.** Concrete made with a combination of expanded clay, shale, slag, slate, sintered fly ash, or any natural lightweight aggregate meeting ASTM C 330 and possessing equivalent fire-resistance properties and natural sand. Its unit weight is generally between  $1,680$  and  $1,920 \text{ kg/m}^3$ .

**CONCRETE, SILICEOUS AGGREGATE.** Concrete made with normal-weight aggregates consisting mainly of silica or compounds other than calcium or magnesium carbonate, which contains more than 40-percent quartz, chert, or flint.

**CONCRETE, VERMICULITE.** A lightweight insulating concrete made with vermiculite concrete aggregate which is laminated micaceous material produced

by expanding the ore at high temperatures. When added to a Portland cement slurry the resulting concrete has a dry unit weight of approximately 480 kg/m<sup>3</sup>.

**GLASS FIBERBOARD.** Fibrous glass roof insulation consisting of inorganic glass fibers formed into rigid boards using a binder. The board has a top surface faced with asphalt and kraft reinforced with glass fiber.

**MINERAL BOARD.** A rigid felted thermal insulation board consisting of either felted mineral fiber or cellular beads of expanded aggregate formed into flat rectangular units.

**TABLE 4B.20.1(1)**  
**MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS NONCOMBUSTIBLE INSULATING MATERIALS**

STRUCTURAL PARTS TO BE PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (mm)			
			4 hour	3 hour	2 hour	1 hour
1. Steel columns and all of primary trusses	1-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete, members 150 × 150 mm or greater (not including sandstone, granite and siliceous gravel) <sup>a</sup>	65	50	40	25
	1-1.2	Carbonate, lightweight and sand-lightweight aggregate concrete, members 200 × 200 mm or greater (not including sandstone, granite and siliceous gravel) <sup>a</sup>	50	40	25	25
	1-1.3	Carbonate, lightweight and sand-lightweight aggregate concrete, members 305 × 305 mm or greater (not including sandstone, granite and siliceous gravel) <sup>a</sup>	40	25	25	25
	1-1.4	Siliceous aggregate concrete and concrete excluded in Item 1-1.1, members 150 × 150 mm or greater <sup>a</sup>	75	50	40	25
	1-1.5	Siliceous aggregate concrete and concrete excluded in Item 1-1.1, members 200 × 200 mm or greater <sup>a</sup>	65	50	25	25
	1-1.6	Siliceous aggregate concrete and concrete excluded in Item 1-1.1, members 305 × 305 mm or greater <sup>a</sup>	50	25	25	25
	1-2.1	Clay or shale brick with brick and mortar fill <sup>a</sup>	95	—	—	60
	1-3.1	100 mm hollow clay tile in two 50 mm layers; 13 mm mortar between tile and column; 10 mm metal mesh 1.2 mm wire diameter in horizontal joints; tile fill <sup>a</sup>	100	—	—	—
	1-3.2	50 mm hollow clay tile; 20 mm mortar between tile and column; 10 mm metal mesh 1.2 mm wire diameter in horizontal joints; limestone concrete fill; <sup>a</sup> plastered with 20 mm gypsum plaster.	75	—	—	—
	1-3.3	50 mm hollow clay tile with outside wire ties 2 mm diameter at each course of tile or 10 mm metal mesh 1.2 mm diameter wire in horizontal joints; limestone or trap-rock concrete fill <sup>1</sup> extending 25 mm outside column on all sides	—	—	75	—
	1-3.4	50 mm hollow clay tile with outside wire ties 2 mm diameter at each course of tile with or without concrete fill; 20 mm mortar between tile and column	—	—	—	50
	1-4.1	Cement plaster over metal lath wire tied to 20 mm cold-rolled vertical channels with 1.3 mm (No. 18 B.W. gage) wire ties spaced 75 to 150 mm on center. Plaster mixed 1: 2 ½ by volume, cement to sand	—	—	65 <sup>b</sup>	22
	1-5.1	Vermiculite concrete, 1:4 mix by volume over paperbacked wire fabric lath wrapped directly around column with additional 50 mm × 50 mm 1.6 mm/1.6 mm (No. 16/16 B.W. gage) wire fabric placed 10 mm from outer concrete surface. Wire fabric tied with 1.3 mm (No. 18 B.W. gage) wire spaced 150 mm on center for inner layer and 50 mm on center for outer layer	50	—	—	—
	1-6.1	Perlite or vermiculite gypsum plaster over metal lath wrapped around column and furred 32 mm from column flanges. Sheets lapped at ends and tied at 150 mm intervals with 1.3 mm (No. 18 B.W. gage) tie wire. Plaster pushed through to flanges	40	25	—	—

(Continued)

**TABLE 4B.20.1(1) – continued**  
**MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS**  
**NONCOMBUSTIBLE INSULATING MATERIALS**

STRUCTURAL PARTS TO BE PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (mm)			
			4 hour	3 hour	2 hour	1 hour
	1-6.2	Perlite or vermiculite gypsum plaster over self-furring metal lath wrapped directly around column, lapped 25 mm and tied at 150 mm intervals with 1.3 mm (No. 18 B.W. gage) wire	45	35	25	—
	1-6.3	Perlite or vermiculite gypsum plaster on metal lath applied to 20 mm cold-rolled channels spaced 610 mm apart vertically and wrapped flatwise around column	40	—	—	—
	1-6.4	Perlite or vermiculite gypsum plaster over two layers of 13 mm plain full-length gypsum lath applied tight to column flanges. Lath wrapped with 25 mm hexagonal mesh of No. 20 gage wire and tied with doubled 0.9 mm diameter (No. 18 B.W. gage) wire ties spaced 585 mm on center. For three-coat work, the plaster mix for the second coat shall not exceed 46 Kg of gypsum to 0.07 m <sup>3</sup> of aggregate for the 3-hour system	65	50	—	—
	1-6.5	Perlite or vermiculite gypsum plaster over one layer of 13 mm plain full-length gypsum lath applied tight to column flanges. Lath tied with doubled 1.3 mm (No. 18 B.W. gage) wire ties spaced 585 mm on center and scratch coat wrapped with 25 mm hexagonal mesh 0.9 mm (No. 20 B.W. gage) wire fabric. For three-coat work, the plaster mix for the second coat shall not exceed 46 Kg of gypsum to 0.07 m <sup>3</sup> of aggregate	—	50	—	—
	1-7.1	Multiple layers of 13 mm gypsum wallboard <sup>c</sup> adhesively <sup>d</sup> secured to column flanges and successive layers. Wallboard applied without horizontal joints. Corner edges of each layer staggered. Wallboard layer below outer layer secured to column with doubled 1.3 mm (No. 18 B.W. gage) steel wire ties spaced 380 mm on center. Exposed corners taped and treated	—	—	50	25
1. Steel columns and all of primary trusses	1-7.2	Three layers of 16 mm Type X gypsum wallboard <sup>c</sup> First and second layer held in place by 3 mm diameter by 35 mm long ring shank nails with 8 mm diameter heads spaced 610 mm on center at corners. Middle layer also secured with metal straps at mid-height and 460 mm from each end, and by metal corner bead at each corner held by the metal straps. Third layer attached to corner bead with 25 mm long gypsum wallboard screws spaced 305 mm on center	—	—	50	—
	1-7.3	Three layers of 16 mm Type X gypsum wallboard <sup>c</sup> each layer screw attached to 40 mm steel studs 0.45 mm thick (No. 25 carbon sheet steel gage) at each corner of column. Middle layer also secured with 1.3 mm (No. 18 B.W. gage) double-strand steel wire ties, 610 mm on center. Screws are No. 6 by 25 mm spaced 610 mm on center for inner layer, No. 6 by 40 mm spaced 305 mm on center for middle layer and No. 8 by 60 mm spaced 305 mm on center for outer layer	—	50	—	—
	1-8.1	Wood-fibered gypsum plaster mixed 1:1 by weight gypsum-to-sand aggregate applied over metal lath. Lath lapped 25 mm and tied 150 mm on center at all end, edges and spacers with 1.3 mm (No. 18 B.W. gage) steel tie wires. Lath applied over 13 mm spacers made of 20 mm furring channel with 50 mm legs bent around each corner. Spacers located 25 mm from top and bottom of member and a maximum of 1 m on center and wire tied with a single strand of 1.3 mm (No. 18 B.W. gage) steel tie wires. Corner bead tied to the lath at 150 mm on center along each corner to provide plaster thickness	—	—	40	—
2. Webs or flanges of steel beams and girders	2-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete (not including sandstone, granite and siliceous gravel) with 75 mm or finer metal mesh placed 25 mm from the finished surface anchored to the top flange and providing not less than 55 square millimeter of steel area per meter in each direction	50	40	25	25
	2-1.2	Siliceous aggregate concrete and concrete excluded in Item 2-1.1 with 75 mm or finer metal mesh placed 25 mm from the finished surface anchored to the top flange and providing not less than 55 square millimeter of steel area per meter in each direction	65	50	40	25
	2-2.1	Cement plaster on metal lath attached to 20 mm cold-rolled channels with 1.3 mm (No. 18 B.W. gage) wire ties spaced 75 to 150 mm on center. Plaster mixed 1: 2 ½ by volume, cement to sand	—	—	65 <sup>b</sup>	22



**TABLE 4B.20.1(1) – continued**  
**MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS**  
**NONCOMBUSTIBLE INSULATING MATERIALS**

STRUCTURAL PARTS TO BE PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (mm)			
			4 hour	3 hour	2 hour	1 hour
	2-3.1	Vermiculite gypsum plaster on a metal lath cage, wire tied to 4.2 mm diameter (No. 8 B.W. gage) steel wire hangers wrapped around beam and spaced 405 mm on center. Metal lath ties spaced approximately 125 mm on center at cage sides and bottom	—	22	—	—
	2-4.1	Two layers of 16 mm Type X gypsum wallboard <sup>c</sup> are attached to U-shaped brackets spaced 610 mm on center. 0.45 mm thick (No. 25 carbon sheet steel gage) 40 mm deep by 25 mm galvanized steel runner channels are first installed parallel to and on each side of the top beam flange to provide a 13 mm clearance to the flange. The channel runners are attached to steel deck or concrete floor construction with approved fasteners spaced 305 mm on center. U-shaped brackets are formed from members identical to the channel runners. At the bent portion of the U-shaped bracket, the flanges of the channel are cut out so that 40 mm deep corner channels can be inserted without attachment parallel to each side of the lower flange. As an alternate, 500 mm thick (No. 24 carbon sheet steel gage) 25 mm × 50 mm runner and corner angles may be used in lieu of channels, and the web cutouts in the U-shaped brackets may be omitted. Each angle is attached to the bracket with 13 mm-long No. 8 self-drilling screws. The vertical legs of the U-shaped bracket are attached to the runners with one 13 mm long No. 8 self-drilling screw. The completed steel framing provides a 55 mm and 40 mm space between the inner layer of wallboard and the sides and bottom of the steel beam, respectively. The inner layer of wallboard is attached to the top runners and bottom corner channels or corner angles with 32 mm-long No. 6 self-drilling screws spaced 405 mm on center. The outer layer of wallboard is applied with 45 mm-long No. 6 self-drilling screws spaced 200 mm on center. The bottom corners are reinforced with metal corner beads	—	—	32	—
2. Webs or flanges of steel beams and girders	2-4.2	Three layers of 16 mm Type X gypsum wallboard <sup>c</sup> attached to a steel suspension system as described immediately above utilizing the 0.45 mm thick (No. 25 carbon sheet steel gage) 25 mm × 50 mm lower corner angles. The framing is located so that a 55 mm and 50 mm space is provided between the inner layer of wallboard and the sides and bottom of the beam, respectively. The first two layers of wallboard are attached as described immediately above. A layer of 0.9 mm thick (No. 20 B.W. gage) 25 mm hexagonal galvanized wire mesh is applied under the soffit of the middle layer and up the sides approximately 50 mm. The mesh is held in position with the No. 6 40 mm-long screws installed in the vertical leg of the bottom corner angles. The outer layer of wallboard is attached with No. 6 60 mm-long screws spaced 200 mm on center. One screw is also installed at the mid-depth of the bracket in each layer. Bottom corners are finished as described above	—	50	—	—
3. Bonded pretensioned reinforcement in prestressed concrete <sup>e</sup>	3-1.1	Carbonate, lightweight, sand-lightweight and siliceous <sup>f</sup> aggregate concrete Beams or girders	100 <sup>g</sup>	75 <sup>g</sup>	65	40
		Solid slabs <sup>h</sup>	—	50	40	25
4. Bonded or unbonded post-tensioned tendons in prestressed concrete <sup>e,i</sup>	4-1.1	Carbonate, lightweight, sand-lightweight and siliceous <sup>f</sup> aggregate concrete unrestrained members: Solid slabs <sup>h</sup>	—	50	40	—
		Beams and girders <sup>j</sup> 200 mm wide greater than 305 mm wide	75	115 65	65 50	45 40
	4-1.2	Carbonate, lightweight, sand-lightweight and siliceous aggregate Restrained members: <sup>k</sup> Solid slabs <sup>h</sup>	32	25	20	—
		Beams and girders <sup>j</sup> 200 mm wide greater than 300 mm wide	65 50	50 45	45 40	— —

(Continued)

**TABLE 4B.20.1(1) – continued**  
**MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS**  
**NONCOMBUSTIBLE INSULATING MATERIALS**

STRUCTURAL PARTS TO BE PROTECTED	ITEM NUMBER	INSULATING MATERIAL USED	MINIMUM THICKNESS OF INSULATING MATERIAL FOR THE FOLLOWING FIRE-RESISTANCE PERIODS (mm)			
			4 hour	3 hour	2 hour	1 hour
5. Reinforcing steel in reinforced concrete columns, beams, girders and trusses	5-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete, members 300 mm or larger, square or round. (Size limit does not apply to beams and girders monolithic with floors)	40	40	40	40
		Siliceous aggregate concrete, members 300mm or larger, square or round. (Size limit does not apply to beams and girders monolithic with floors)	50	40	40	40
6. Reinforcing steel in reinforced concrete joists <sup>l</sup>	6-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete.	32	32	25	20
	6-1.2	Siliceous aggregate concrete	45	40	25	20
7. Reinforcing and tie rods in floor and roof slabs <sup>l</sup>	7-1.1	Carbonate, lightweight and sand-lightweight aggregate concrete.	25	25	20	20
	7-1.2	Siliceous aggregate concrete	32	25	25	20

- a. Reentrant parts of protected members to be filled solidly.
- b. Two layers of equal thickness with a 20 mm airspace in between.
- c. For all of the construction with gypsum wallboard described in Table 4B.20.1(1), gypsum base for veneer plaster of the same size, thickness and core type shall be permitted to be substituted for gypsum wallboard, provided attachment is identical to that specified for the wallboard and the joints on the face layer are reinforced, and the entire surface is covered with a minimum of 1.6 mm gypsum veneer plaster.
- d. An approved adhesive qualified under ASTM E 119.
- e. Where lightweight or sand-lightweight concrete having an oven-dry weight of 1,760 kilogram per cubic meter or less is used, the tabulated minimum cover shall be permitted to be reduced 25 percent, except that in no case shall the cover be less than 20 mm in slabs or 40 mm in beams or girders.
- f. For solid slabs of siliceous aggregate concrete, increase tendon cover 20 percent.
- g. Adequate provisions against spalling shall be provided by U-shaped or hooped stirrups spaced not to exceed the depth of the member with a clear cover of 25 mm.
- h. Prestressed slabs shall have a thickness not less than that required in Table 4B.20.1(3) for the respective fire resistance time period.
- i. Fire coverage and end anchorages shall be as follows: Cover to the prestressing steel at the anchor shall be 13 mm greater than that required away from the anchor. Minimum cover to steel-bearing plate shall be 25 mm in beams and 20 mm in slabs.
- j. For beam widths between 200 mm and 305 mm, cover thickness shall be permitted to be determined by interpolation.
- k. Interior spans of continuous slabs, beams and girders shall be permitted to be considered restrained.
- l. For use with concrete slabs having a comparable fire endurance where members are framed into the structure in such a manner as to provide equivalent performance to that of monolithic concrete construction.

**TABLE 4B.20.1(2)**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
1. Brick of clay or shale	1-1.1	Solid brick of clay or shale <sup>c</sup>	150	125	95	70
	1-1.2	Hollow brick, not filled.	125	110	85	60
	1-1.3	Hollow brick unit wall, grout or filled with perlite, vermiculite or expanded shale aggregate.	170	140	110	75
	1-2.1	100 mm nominal thick units at least 75 percent solid backed with a hat-shaped metal furring channel 20 mm thick formed from 500 mm sheet metal attached to the brick wall on 610 mm centers with approved fasteners, and 13 mm Type X gypsum wallboard attached to the metal furring strips with 25 mm-long Type S screws spaced 200 mm on center	—	—	125 <sup>d</sup>	—
2. Combination of clay brick and load-bearing hollow clay tile	2-1.1	100 mm solid brick and 100 mm tile (at least 40 percent solid)	—	200	—	—
	2-1.2	100 mm solid brick and 200 mm tile (at least 40 percent solid)	300	—	—	—
3. Concrete masonry units	3-1.1 <sup>f,g</sup>	Expanded slag or pumice	120	100	80	55
	3-1.2 <sup>f,g</sup>	Expanded clay, shale or slate	130	110	90	65
	3-1.3 <sup>f</sup>	Limestone, cinders or air-cooled slag	150	125	100	70
	3-1.4 <sup>f,g</sup>	Calcareous or siliceous gravel	160	135	105	70
4. Solid concrete <sup>h,i</sup>	4-1.1	Siliceous aggregate concrete	180	160	125	90
		Carbonate aggregate concrete	170	145	115	80
		Sand-lightweight concrete	135	115	95	70
		Lightweight concrete	130	110	90	65
5. Glazed or unglazed facing tile, nonload-bearing	5-1.1	One 50 mm unit cored 15 percent maximum and one 100 mm unit cored 25 percent maximum with 20 mm mortar-filled collar joint. Unit positions reversed in alternate courses	—	160	—	—
	5-1.2	One 50 mm unit cored 15 percent maximum and one 100 mm unit cored 40 percent maximum with 20 mm mortar-filled collar joint. Unit positions side with 20 mm gypsum plaster. Two wythes tied together every fourth course with 0.8 mm (No. 22 gage) corrugated metal ties	—	170	—	—
	5-1.3	One unit with three cells in wall thickness, cored 29 percent maximum	—	—	150	—
	5-1.4	One 50 mm unit cored 22 percent maximum and one 100 mm unit cored 41 percent maximum with 6 mm mortar-filled collar joint. Two wythes tied together every third course with 0.8 mm (No. 22 galvanized sheet steel gage) corrugated metal ties	—	—	150	—
	5-1.5	One 100 mm unit cored 25 percent maximum with 20 mm gypsum plaster on one side	—	—	120	—
	5-1.6	One 100 mm unit with two cells in wall thickness, cored 22 percent maximum	—	—	—	100
	5-1.7	One 100 mm unit cored 30 percent maximum with 20 mm vermiculite gypsum plaster on one side	—	—	115	—
	5-1.8	One 100 mm unit cored 39 percent maximum with 20 mm gypsum plaster on one side	—	—	—	115
6. Solid gypsum plaster	6-1.1	20 mm by 1.4 mm (No. 16 carbon sheet steel gage) vertical cold-rolled channels, 405 mm on center with 1.2 kilogram flat metal lath applied to one face and tied with 1.3 mm (No. 18 B.W. Gage) wire at 150 mm spacing. Gypsum plaster each side mixed 1:2 by weight, gypsum to sand aggregate	—	—	—	50 <sup>d</sup>
	6-1.2	20 mm by 1.4 mm (No. 16 carbon sheet steel gage) cold-rolled channels 405 mm on center with metal lath applied to one face and tied with 1.3 mm (No. 18 B.W. gage) wire at 150 mm spacing. Perlite or vermiculite gypsum plaster each side. For three-coat work, the plaster mix for the second coat shall not exceed 46 kilograms of gypsum to 0.07 m <sup>3</sup> of aggregate for the 1-hour system			65 <sup>d</sup>	50 <sup>d</sup>

(Continued)

TYPES OF CONSTRUCTION AND FIRE-RESISTANCE-RATED CONSTRUCTION

**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
6. Solid gypsum plaster	6-1.3	20 mm by 1.4 mm (No. 16 carbon sheet steel gage) vertical cold-rolled channels, 400 mm on center with 10 mm gypsum lath applied to one face and attached with sheet metal clips. Gypsum plaster each side mixed 1:2 by weight, gypsum to sand aggregate	—	—	—	50 <sup>d</sup>
	6-2.1	Studless with 13 mm full-length plain gypsum lath and gypsum plaster each side. Plaster mixed 1:1 for scratch coat and 1:2 for brown coat, by weight, gypsum to sand aggregate	—	—	—	50 <sup>d</sup>
	6-2.2	Studless with 13 mm full-length plain gypsum lath and perlite or vermiculite gypsum plaster each side	—	—	65 <sup>d</sup>	50 <sup>d</sup>
	6-2.3	Studless partition with 10 mm rib metal lath installed vertically adjacent edges tied 150 mm on center with 1.3 mm (No. 18 gage) wire ties, gypsum plaster each side mixed 1:2 by weight, gypsum to sand aggregate	—	—	—	50 <sup>d</sup>
7. Solid perlite and portland cement	7-1.1	Perlite mixed in the ratio of 0.08 cubic meters to 46 kilograms of portland cement and machine applied to stud side of 40 mm mesh by 1.5-mm (No. 17 B.W. gage) paper-backed woven wire fabric lath wire-tied to 100 mm-deep steel trussed wire <sup>i</sup> studs 405 mm on center. Wire ties of 1.3 mm (No. 18 B.W. gage) galvanized steel wire 150 mm on center vertically	—	—	80 <sup>d</sup>	—
8. Solid neat wood fibered gypsum plaster	8-1.1	20 mm by 1.4 mm (No. 16 carbon sheet steel gage) cold-rolled channels, 305 mm on center with 1.2 kilogram flat metal lath applied to one face and tied 1.3 mm (No. 18 B.W. gage) wire at 150 mm spacing. Neat gypsum plaster applied each side	—	—	50 <sup>d</sup>	—
9. Solid wallboard partition	9-1.1	One full-length layer 13 mm Type X gypsum wallboard <sup>e</sup> laminated to each side of 25 mm full-length V-edge gypsum coreboard with approved laminating compound. Vertical joints of face layer and coreboard staggered at least 75 mm	—	—	50 <sup>d</sup>	—
10. Hollow (studless) gypsum wallboard partition	10-1.1	One full-length layer of 16 mm Type X gypsum wallboard <sup>e</sup> attached to both sides of wood or metal top and bottom runners laminated to each side of 25 mm× 150 mm full-length gypsum coreboard ribs spaced 610 mm on center with approved laminating compound. Ribs centered at vertical joints of face plies and joints staggered 610 mm in opposing faces. Ribs may be recessed 150 mm from the top and bottom	—	—	—	60 <sup>d</sup>
	10-1.2	25 mm regular gypsum V-edge full-length backing board attached to both sides of wood or metal top and bottom runners with nails or 40 mm drywall screws at 610 mm on center. Minimum width of runners 40 mm. Face layer of 13 mm regular full-length gypsum wallboard laminated to outer faces of backing board with approved laminating compound	—	—	115 <sup>d</sup>	—
11. Noncombustible studs—interior partition with plaster each side	11-1.1	85 mm × 1.1 mm (No. 18 carbon sheet steel gage) steel studs spaced 610 mm on center. 16 mm gypsum plaster on metal lath each side mixed 1:2 by weight, gypsum to sand aggregate	—	—	—	120 <sup>d</sup>
	11-1.2	85 mm × 1.4 mm (No. 16 carbon sheet steel gage) approved nailable <sup>k</sup> studs spaced 610 mm on center. 16 mm neat gypsum wood-fibered plaster each side over 10 mm rib metal lath nailed to studs with 6d common nails, 200 mm on center. Nails driven 32 mm and bent over	—	—	140	—
	11-1.3	100 mm × 1.1 mm (No. 18 carbon sheet steel gage) channel-shaped steel studs at 405 mm on center. On each side approved resilient clips pressed onto stud flange at 405 mm vertical spacing, 6 mm pencil rods snapped into or wire tied onto outer loop of clips, metal lath wire-tied to pencil rods at 150 mm intervals, 50 mm perlite gypsum plaster, each side	—	195 <sup>d</sup>	—	—

(Continued)

**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
	11-1.4	65 mm × 1.1 mm (No. 18 carbon sheet steel gage) steel studs spaced 405 mm on center. Wood fibered gypsum plaster mixed 1:1 by weight gypsum to sand aggregate applied on 0.34-kilograms metal lath wire tied to studs, each side. 20 mm plaster applied over each face, including finish coat	—	—	110 <sup>d</sup>	—
12. Wood studs interior partition with plaster each side	12-1.1 <sup>l,m</sup>	50 mm × 100 mm wood studs 405 mm on center with 16 mm gypsum plaster on metal lath. Lath attached by 4d common nails bent over or No. 14 gage by 32 mm by 20 mm crown width staples spaced 150 mm on center. Plaster mixed 1:1 1/2 for scratch coat and 1:3 for brown coat, by weight, gypsum to sand aggregate	—	—	—	130
	12-1.2 <sup>l</sup>	50 × 100 mm wood studs 405 mm on center with metal lath and 22 mm neat wood-fibered gypsum plaster each side. Lath attached by 6d common nails, 180 mm on center. Nails driven 32 mm and bent over	—	—	140 <sup>d</sup>	—
	12-1.3 <sup>l</sup>	50 mm × 100 mm wood studs 405 mm on center with 10 mm perforated or plain gypsum lath and 13 mm gypsum plaster each side. Lath nailed with 30 mm by No. 13 gage by 8 mm head plasterboard blued nails, 100 mm on center. Plaster mixed 1:2 by weight, gypsum to sand aggregate	—	—	—	135
	12-1.4 <sup>l</sup>	50 mm × 100 mm wood studs 405 mm on center with 10 mm Type X gypsum lath and 13 mm gypsum plaster each side. Lath nailed with 30 mm by No. 13 gage by 8 mm head plasterboard blued nails, 125 mm on center. Plaster mixed 1:2 by weight, gypsum to sand aggregate	—	—	—	135
13. Non-combustible studs—interior partition with gypsum wallboard each side	13-1.1	0.45 mm (No. 25 carbon sheet steel gage) channel-shaped studs 610 mm on center with one full-length layer of 16 mm Type X gypsum wallboard <sup>c</sup> applied vertically attached with 25 mm long No. 6 drywall screws to each stud. Screws are 200 mm on center around the perimeter and 305 mm on center on the intermediate stud. The wallboard may be applied horizontally when attached to 90 mm studs and the horizontal joints are staggered with those on the opposite side. Screws for the horizontal application shall be 200 mm on center at vertical edges and 305 mm on center at intermediate studs	—	—	—	75 <sup>d</sup>
	13-1.2	0.45 mm (No. 25 carbon sheet steel gage) channel-shaped studs 635 mm on center with two full-length layers of 13 mm Type X gypsum wallboard <sup>c</sup> applied vertically each side. First layer attached with 25 mm-long, No. 6 drywall screws, 200 mm on center around the perimeter and 305 mm on center on the intermediate stud. Second layer applied with vertical joints offset one stud space from first layer using 40 mm long, No. 6 drywall screws spaced 230 mm on center along vertical joints, 305 mm on center at intermediate studs and 640 mm on center along top and bottom runners	—	—	90 <sup>d</sup>	—
	13-1.3	1.4 mm (No. 16 carbon sheet steel gage) approved nailable metal studs <sup>c</sup> 610 mm on center with full-length 16 mm Type X gypsum wallboard <sup>c</sup> applied vertically and nailed 180 mm on center with 6d cement-coated common nails. Approved metal fastener grips used with nails at vertical butt joints along studs	—	—	—	125
14. Wood studs—interior partition with gypsum Wallboard each side	14-1.1 <sup>h,m</sup>	50 mm × 100 mm wood studs 405 mm on center with two layers of 10 mm regular gypsum wallboard <sup>c</sup> each side, 4d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 200 mm on center first layer, 5d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 200 mm on center second layer with laminating compound between layers, joints staggered. First layer applied full length vertically, second layer applied horizontally or vertically	—	—	—	125

(Continued)

TYPES OF CONSTRUCTION AND FIRE-RESISTANCE-RATED CONSTRUCTION

**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
14. Wood studs— interior partition with gypsum Wallboard each side	14-1.2 <sup>1,m</sup>	50 mm × 100 mm wood studs 405 mm on center with two layers 13 mm regular gypsum wallboard <sup>c</sup> applied vertically or horizontally each side <sup>k</sup> , joints staggered. Nail base layer with 5d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 200 mm on center face layer with 8d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 200 mm on center	—	—	—	140
	14-1.3 <sup>1,m</sup>	50 mm × 100 mm wood studs 610 mm on center with 16 mm Type X gypsum wallboard <sup>c</sup> applied vertically or horizontally nailed with 6d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 180 mm on center with end joints on nailing members. Stagger joints each side	—	—	—	120
	14-1.4 <sup>1</sup>	50 mm × 100 mm fire-retardant-treated wood studs spaced 610 mm on center with one layer of 16 mm Type X gypsum wallboard <sup>c</sup> applied with face paper grain (long dimension) parallel to studs. Wallboard attached with 6d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 180 mm on center	—	—	—	120 <sup>d</sup>
	14-1.5 <sup>1,m</sup>	50 mm × 100 mm wood studs 405 mm on center with two layers 16 mm Type X gypsum wallboard <sup>c</sup> each side. Base layers applied vertically and nailed with 6d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 230 mm on center. Face layer applied vertically or horizontally and nailed with 8d cooler <sup>n</sup> or wallboard <sup>n</sup> nails at 180 mm on center. For nail-adhesive application, base layers are nailed 150 mm on center. Face layers applied with coating of approved wallboard adhesive and nailed 305 mm on center	—	—	150	—
	14-1.6 <sup>1</sup>	50 mm × 75 mm fire-retardant-treated wood studs spaced 610 mm on center with one layer of 16 mm Type X gypsum wallboard <sup>c</sup> applied with face paper grain (long dimension) at right angles to studs. Wallboard attached with 6d cement-coated box nails spaced 180 mm on center	—	—	—	90 <sup>d</sup>
15. Exterior or interior walls	15-1.1 <sup>1,m</sup>	Exterior surface with 20 mm drop siding over 13 mm gypsum sheathing on 50 mm × 100 mm wood studs at 405 mm on center, interior surface treatment as required for 1-hour-rated exterior or interior 50 mm × 100 mm wood stud partitions. Gypsum sheathing nailed with 45 mm by No. 11 gage by 11 mm head galvanized nails at 200 mm on center. Siding nailed with 7d galvanized smooth box nails	—	—	—	Varies
	15-1.2 <sup>1,m</sup>	50 mm × 100 mm wood studs 405 mm on center with metal lath and 20 mm cement plaster on each side. Lath attached with 6d common nails 180 mm on center driven to 25 mm minimum penetration and bent over. Plaster mix 1:4 for scratch coat and 1:5 for brown coat, by volume, cement to sand	—	—	—	135
	15-1.3 <sup>1,m</sup>	50 mm × 100 mm wood studs 405 mm on center with 22 mm cement plaster (measured from the face of studs) on the exterior surface with interior surface treatment as required for interior wood stud partitions in this table. Plaster mix 1:4 for scratch coat and 1:5 for brown coat, by volume, cement to sand	—	—	—	Varies
	15-1.4	90 mm No. 16 gage noncombustible studs 405 mm on center with 22 mm cement plaster (measured from the face of the studs) on the exterior surface with interior surface treatment as required for interior, nonbearing, noncombustible stud partitions in this table. Plaster mix 1:4 for scratch coat and 1:5 for brown coat, by volume, cement to sand	—	—	—	Varies <sup>d</sup>

(Continued)

**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
15. Exterior or interior walls	15-1.5 <sup>m</sup>	60 mm × 95 mm clay face brick with cored holes over 13 mm gypsum sheathing on exterior surface of 50 mm × 100 mm wood studs at 405 mm on center and two layers 16 mm Type X gypsum wallboard <sup>c</sup> on interior surface. Sheathing placed horizontally or vertically with vertical joints over studs nailed 150 mm on center with 45 mm × No. 11 gage by 11 mm head galvanized nails. Inner layer of wallboard placed horizontally or vertically and nailed 200 mm on center with 6d cooler <sup>n</sup> or wallboard <sup>n</sup> nails. Outer layer of wallboard placed horizontally or vertically and nailed 200 mm on center with 8d cooler <sup>n</sup> or wallboard <sup>n</sup> nails. All joints staggered with vertical joints over studs. Outer layer joints taped and finished with compound. Nail heads covered with joint compound. 0.9 mm (No. 20 galvanized sheet gage) corrugated galvanized steel wall ties 20 mm by 170 mm attached to each stud with two 8d cooler <sup>n</sup> or wallboard <sup>n</sup> nails every sixth course of bricks	—	—	250	—
	15-1.6 <sup>l,m</sup>	50 mm × 150 mm fire-retardant-treated wood studs 405 mm on center. Interior face has two layers of 16 mm Type X gypsum with the base layer placed vertically and attached with 6d box nails 305 mm on center. The face layer is placed horizontally and attached with 8d box nails 200 mm on center at joints and 305 mm on center elsewhere. The exterior face has a base layer of 16 mm Type X gypsum sheathing placed vertically with 6d box nails 200 mm on center at joints and 305 mm on center elsewhere. An approved building paper is next applied, followed by self-furred exterior lath attached with 65 mm, No. 12 gage galvanized roofing nails with a 10 mm diameter head and spaced 150 mm on center along each stud. Cement plaster consisting of a 13 mm brown coat is then applied. The scratch coat is mixed in the proportion of 1:3 by weight, cement to sand with 4.5 kilograms of hydrated lime and 1.5 kilograms of approved additives or admixtures per sack of cement. The brown coat is mixed in the proportion of 1:4 by weight, cement to sand with the same amounts of hydrated lime and approved additives or admixtures used in the scratch coat	—	—	210	—
	15-1.7 <sup>l,m</sup>	50 mm × 150 mm wood studs 405 mm on center. The exterior face has a layer of 16 mm Type X gypsum sheathing placed vertically with 6d box nails 200 mm on center at joints and 305 mm on center elsewhere. An approved building paper is next applied, followed by 25 mm by No. 18 gage self-furred exterior lath attached with 8d by 65 mm long galvanized roofing nails spaced 150 mm on center along each stud. Cement plaster consisting of a 13 mm scratch coat, a bonding agent and a 13 mm brown coat and a finish coat is then applied. The scratch coat is mixed in the proportion of 1:3 by weight, cement to sand with 4.5 kilograms of hydrated lime and 1.5 kilograms of approved additives or admixtures per sack of cement. The brown coat is mixed in the proportion of 1:4 by weight, cement to sand with the same amounts of hydrated lime and approved additives or admixtures used in the scratch coat. The interior is covered with 10 mm gypsum lath with 25 mm hexagonal mesh of 0.9 mm (No. 20 B.W. gage) woven wire lath furred out 8 mm and 25 mm perlite or vermiculite gypsum plaster. Lath nailed with 30 mm by No. 13 gage by	—	—	215	—

(Continued)



**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
15. Exterior or interior walls		8 mm head plasterboard glued nails spaced 125 mm on center. Mesh attached by 45 mm by No. 12 gage by 10 mm head nails with 10 mm furrings, spaced 200 mm on center. The plaster mix shall not exceed 46 kilograms of gypsum to 0.07 m <sup>3</sup> of aggregate				
	15-1.8 <sup>lm</sup>	50 mm × 150 mm wood studs 405 mm on center. The exterior face has a layer of 16 mm Type X gypsum sheathing placed vertically with 6d box nails 200 mm on center at joints and 305 mm on center elsewhere. An approved building paper is next applied, followed by 40 mm by No. 17 gage self-furred exterior lath attached with 8d by 65 mm long galvanized roofing nails spaced 150 mm on center along each stud. Cement plaster consisting of a 13 mm scratch coat, and a 13 mm brown coat is then applied. The plaster may be placed by machine. The scratch coat is mixed in the proportion of 1:4 by weight, plastic cement to sand. The brown coat is mixed in the proportion of 1:5 by weight, plastic cement to sand. The interior is covered with 10 mm gypsum lath with 25 mm hexagonal mesh of No. 20 gage woven wire lath furred out 8 mm and 25 mm perlite or vermiculite gypsum plaster. Lath nailed with 30 mm by No. 13 gage by 8 mm head plasterboard glued nails spaced 125 mm on center. Mesh attached by 45 mm by No. 12 gage by 10 mm head nails with 10 mm furrings, spaced 200 mm on center. The plaster mix shall not exceed 46 kilograms of gypsum to 0.07 cubic meters of aggregate	—	—	215	—
	15-1.9	100 mm No. 18 gage, nonload-bearing metal studs, 405 mm on center, with 25 mm portland cement lime plaster [measured from the back side of the 0.34-kilograms expanded metal lath] on the exterior surface. Interior surface to be covered with 25 mm of gypsum plaster on 0.34 kilograms expanded metal lath proportioned by weight – 1:2 or scratch coat, 1:3 for brown, gypsum to sand. Lath on one side of the partition fastened to 6 mm diameter pencil rods supported by No. 20 gage metal clips, located 405 mm on center vertically, on each stud. 75 mm thick mineral fiber insulating batts friction fitted between the studs	—	—	165 <sup>d</sup>	—
	15-1.10	Steel studs 1.5 mm thick, 100 mm deep or 150 mm at 405 mm or 610 mm centers, with 13 mm Glass Fiber Reinforced Concrete (GFRC) on the exterior surface. GFRC is attached with flex anchors at 610 mm on center, with 125 mm leg welded to studs with two 13 mm-long flare-bevel welds, and 100 mm foot attached to the GFRC skin with 16 mm thick GFRC bonding pads that extend 65 mm beyond the flex anchor foot on both sides. Interior surface to have two layers of 13 mm Type X gypsum wallboard <sup>c</sup> . The first layer of wallboard to be attached with 25 mm-long Type S buglehead screws spaced 610 mm on center and the second layer is attached with 40 mm-long Type S screws spaced at 305 mm on center. Cavity is to be filled with 125 mm of 65 kg/m <sup>3</sup> (nominal) mineral fiber batts. GFRC has 40 mm returns packed with mineral fiber and caulked on the exterior	—	—	165	—

(Continued)



**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
15. Exterior or interior walls	15-1.11	Steel studs 1.5 mm thick, 100 mm deep or 150 mm at 405 mm or 610 mm centers, respectively, with 13 mm Glass Fiber Reinforced Concrete (GFRC) on the exterior surface. GFRC is attached with flex anchors at 610 mm on center, with 125 mm leg welded to studs with two 13 mm-long flare-bevel welds, and 100 mm foot attached to the GFRC skin with 16 mm-thick GFRC bonding pads that extend 65 mm beyond the flex anchor foot on both sides. Interior surface to have one layer of 16 mm Type X gypsum wallboard <sup>c</sup> , attached with 32 mm-long Type S buglehead screws spaced 305 mm on center. Cavity is to be filled with 125 mm of 65 kg/m <sup>3</sup> (nominal) mineral fiber batts. GFRC has 40 mm returns packed with mineral fiber and caulked on the exterior	—	—	—	155
	15-1.12 <sup>q</sup>	50 mm × 150 mm wood studs at 405 mm with double top plates, single bottom plate; interior and exterior sides covered with 16 mm Type X gypsum wallboard, 1.22 m wide, applied horizontally or vertically with vertical joints over studs, and fastened with 60 mm Type S drywall screws, spaced 305 mm on center. Cavity filled with 140 mm mineral wool insulation	—	—	—	170
	15-1.13 <sup>q</sup>	50 mm × 150 mm wood studs at 405 mm with double top plates, single bottom plate; interior and exterior sides covered with 16 mm Type X gypsum wallboard, 1.22 m wide, applied horizontally or vertically with vertical joints over studs, and fastened with 60 mm Type S drywall screws, spaced 180 mm on center. Cavity to be filled with 140 mm mineral wool insulation minimum 41 kg/m <sup>3</sup> (nominal)	—	—	—	170
	15-1.14 <sup>q</sup>	50 mm × 100 mm wood studs at 405 mm with double top plates, single bottom plate; interior and exterior sides covered with 16 mm Type X gypsum wallboard and sheathing, respectively, 1.22 m wide, applied horizontally or vertically with vertical joints over studs, and fastened with 60 mm Type S drywall screws, spaced 305 mm on center. Cavity to be filled with 90 mm mineral wool insulation	—	—	—	120
	15-1.15 <sup>q</sup>	50 mm × 100 mm wood studs at 405 mm with double top plates, single bottom plate; interior sides covered with 16 mm Type X gypsum wallboard, 1.22 m wide, applied horizontally unblocked, and fastened with 60 mm Type S drywall screws, spaced 305 mm on center, wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound. Exterior covered with 10 mm wood structural panels (oriented strand board), applied vertically, horizontal joints blocked and fastened with 6d common nails (bright) – 305 mm on center in the field, 150 mm on center panel edges. Cavity to be filled with 90 mm mineral wool insulation. Rating established for exposure from interior side only	—	—	—	115
	15-1.16 <sup>q</sup>	50 mm × 150 mm wood studs at 405 mm centers with double top plates, single bottom plate; interior side covered with 16 mm Type X gypsum wallboard, 1.22 m wide, applied horizontally or vertically with vertical joints over studs and fastened with 60 mm Type S drywall screws, spaced 305 mm on center, exterior side covered with 11 mm wallboard joints covered with paper tape and joint compound, fastener heads covered with joint	—	—	—	165

(Continued)

**TABLE 4B.20.1(2) – continued**  
**RATED FIRE-RESISTANCE PERIODS FOR VARIOUS WALLS AND PARTITIONS<sup>a,o,p</sup>**

MATERIAL	ITEM NUMBER	CONSTRUCTION	MINIMUM FINISHED THICKNESS FACE-TO-FACE <sup>b</sup> (mm)			
			4 hour	3 hour	2 hour	1 hour
		compound; wood structural panels (oriented strand board) fastened with 6d common nails (bright) spaced 305 mm on center in the field and 150 mm on center along the panel edges. Cavity to be filled with 140 mm mineral wool insulation. Rating established from the gypsum-covered side only				
	15-1.17 <sup>a</sup>	50 mm × 150 mm wood studs at 610 mm centers with double top plates, single bottom plate; interior and exterior side covered with two layers of 16 mm Type X gypsum wallboard, 1.22 m wide, applied horizontally with vertical joints over studs. Base layer fastened with 60 mm. Type S drywall screws, spaced 610 mm on center, and face layer fastened with Type S drywall screws, spaced 200 mm on center, wallboard joints covered with paper tape and joint compound, fastened heads covered with joint compound. Cavity to be filled with 140 mm mineral wool insulation	—	—	195	—
16. Exterior walls rated for fire resistance from the inside only in accordance with Section 4B.4.5.	16-1.1 <sup>a</sup>	50 mm × 100 mm wood studs at 405 mm centers with double top plates, single bottom plate; interior side covered with 16 mm Type X gypsum wallboard, 1.22 m wide, applied horizontally unblocked, and fastened with 60 mm. Type S drywall screws, spaced 305 mm on center, wallboard joints covered with paper tape and joint compound, fastener heads covered with joint compound. Exterior covered with 10 mm wood structural panels (oriented strand board), applied vertically, horizontal joints blocked and fastened with 6d common nails (bright) – 305 mm on center in the field, and 150 mm on center panel edges. Cavity to be filled with 90 mm mineral wool insulation. Rating established for exposure from interior side only	—	—	—	115

- Staples with equivalent holding power and penetration shall be permitted to be used as alternate fasteners to nails for attachment to wood framing.
- Thickness shown for brick and clay tile are nominal thicknesses unless plastered, in which case thicknesses are net. Thickness shown for concrete masonry and clay masonry is equivalent thickness defined in Section 4B.21.3.1 for concrete masonry and Section 4B.21.4.1.1 for clay masonry. Where all cells are solid grouted or filled with silicone-treated perlite loose-fill insulation; vermiculite loose-fill insulation; or expanded clay, shale or slate lightweight aggregate, the equivalent thickness shall be the thickness of the block or brick using specified dimensions as defined in SBC 305. Equivalent thickness may also include the thickness of applied plaster and lath or gypsum wallboard, where specified.
- For units in which the net cross-sectional area of cored brick in any plane parallel to the surface containing the cores is at least 75 percent of the gross cross-sectional area measured in the same plane.
- Shall be used for nonbearing purposes only.
- For all of the construction with gypsum wallboard described in this table, gypsum base for veneer plaster of the same size, thickness and core type shall be permitted to be substituted for gypsum wallboard, provided attachment is identical to that specified for the wallboard, and the joints on the face layer are reinforced and the entire surface is covered with a minimum of 1.6 mm gypsum veneer plaster.
- The fire-resistance time period for concrete masonry units meeting the equivalent thicknesses required for a 2-hour fire-resistance rating in Item 3, and having a thickness of not less than 195 mm is 4 hours when cores which are not grouted are filled with silicone-treated perlite loose-fill insulation; vermiculite loose-fill insulation; or expanded clay, shale or slate lightweight aggregate, sand or slag having a maximum particle size of 10 mm.
- The fire-resistance rating of concrete masonry units composed of a combination of aggregate types or where plaster is applied directly to the concrete masonry shall be determined in accordance with ACI 216.1/TMS 216. Lightweight aggregates shall have a maximum combined density of 1,040 kilograms per cubic meter.
- See also Note b. The equivalent thickness shall be permitted to include the thickness of cement plaster or 1.5 times the thickness of gypsum plaster applied in accordance with the requirements of Chapter 10 of the SBC 201.
- Concrete walls shall be reinforced with horizontal and vertical temperature reinforcement as required by SBC 304.
- Studs are welded truss wire studs with 4.5 mm (No. 7 B.W. gage) flange wire and 4.5 mm (No. 7 B.W. gage) truss wires.
- Nailable metal studs consist of two channel studs spot welded back to back with a crimped web forming a nailing groove.
- Wood structural panels shall be permitted to be installed between the fire protection and the wood studs on either the interior or exterior side of the wood frame assemblies in this table, provided the length of the fasteners used to attach the fire protection are increased by an amount at least equal to the thickness of the wood structural panel.
- The design stress of studs shall be reduced to 78 percent of allowable  $F'_c$  with the maximum not greater than 78 percent of the calculated stress with studs having a slenderness ratio  $l/d$  of 33.
- For properties of cooler or wallboard nails, see ASTM C 514, ASTM C 547 or ASTM F 1667.
- Generic fire-resistance ratings (those not designated as PROPRIETARY in the listing) in the GA 600 shall be accepted as if herein listed.
- NCMA TEK 5-8, shall be permitted for the design of fire walls.
- The design stress of studs shall be equal to a maximum of 100 percent of the allowable  $F'_c$  calculated in accordance with Section 2306 of the Saudi Building Code.

**TABLE 4B.20.1(3)**  
**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS<sup>a, q</sup>**

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (mm)				MINIMUM THICKNESS OF CEILING (mm)			
			4 hour	3 hour	2 hour	1 hour	4 hour	3 hour	2 hour	1 hour
1. Siliceous aggregate concrete	1-1.1	Slab (no ceiling required). Minimum cover over nonprestressed reinforcement shall not be less than 20 mm <sup>b</sup>	180	160	125	90	—	—	—	—
2. Carbonate aggregate concrete	2-1.1		170	145	115	80	—	—	—	—
3. Sand-lightweight concrete	3-1.1		135	115	95	70	—	—	—	—
4. Lightweight concrete	4-1.1		130	110	90	65	—	—	—	—
5. Reinforced concrete	5-1.1	Slab with suspended ceiling of vermiculite gypsum plaster over metal lath attached to 20 mm cold-rolled channels spaced 305 mm on center. Ceiling located 150 mm minimum below joists	75	50	—	—	25	20	—	—
	5-2.1	10 mm Type X gypsum wallboard <sup>c</sup> attached to 0.45 mm (No. 25 carbon sheet steel gage) by 22 mm deep by 65 mm hat-shaped galvanized steel channels with 25 mm-long No. 6 screws. The channels are spaced 610 mm on center, span 890 mm and are supported along their length at 890 mm intervals by 0.8-millimeter (No. 21 galvanized sheet gage) galvanized steel flat strap hangers having formed edges that engage the lips of the channel. The strap hangers are attached to the side of the concrete joists with 4 mm by 32 mm long power-driven fasteners. The wallboard is installed with the long dimension perpendicular to the channels. All end joints occur on channels and supplementary channels are installed parallel to the main channels, 305 mm each side, at end joint occurrences. The finished ceiling is located approximately 305 mm below the soffit of the floor slab	—	—	65	—	—	—	16	—
6. Steel joists constructed with a poured reinforced concrete slab on metal lath forms or steel form units <sup>d,e</sup>	6-1.1	Gypsum plaster on metal lath attached to the bottom cord with single 1.6 mm (No. 16 gage) or doubled 1.3 mm (No. 18 gage) wire ties spaced 150 mm on center. Plaster mixed 1:2 for scratch coat, 1:3 for brown coat, by weight, gypsum-to-sand aggregate for 2-hour system. For 3-hour system plaster is neat	—	—	65	60	—	—	20	16
	6-2.1	Vermiculite gypsum plaster on metal lath attached to the bottom chord with single 1.6 mm (No. 16 gage) or doubled 1.3 mm (No. 18 B.W. gage) wire ties 150 mm on center	—	50	—	—	—	16	—	—
	6-3.1	Cement plaster over metal lath attached to the bottom chord of joists with single 1.6 mm (No. 16 gage) or doubled 1.3 mm (No. 18 B.W. gage) wire ties spaced 150 mm on center. Plaster mixed 1:2 for scratch coat, 1:3 for brown coat for 1-hour system and 1:1 for scratch coat, 1:1 ½ for brown coat for 2-hour system, by weight, cement to sand	—	—	—	50	—	—	—	16 <sup>f</sup>
	6-4.1	Ceiling of 16 mm Type X wallboard <sup>c</sup> attached to 22 mm deep by 65 mm by 0.5 mm (No. 25 carbon sheet steel gage) hat-shaped furring channels 305 mm on center with 25 mm long No. 6 wallboard screws at 200 mm on center. Channels wire tied to bottom chord of joists with doubled 1.3 mm (No. 18 B.W. gage) wire or suspended below joists on wire hangers <sup>g</sup>	—	—	65	—	—	—	16	—

(Continued)

**TABLE 4B.20.1(3) – continued**  
**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS<sup>a, q</sup>**

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (mm)				MINIMUM THICKNESS OF CEILING (mm)			
			4 hour	3 hour	2 hour	1 hour	4 hour	3 hour	2 hour	1 hour
6. Steel joists constructed with a poured reinforced concrete slab on metal lath forms or steel form units <sup>d,e</sup>	6-5.1	Wood-fibred gypsum plaster mixed 1:1 by weight gypsum to sand aggregate applied over metal lath. Lath tied 150 mm, on center to 20 mm channels spaced 345 mm on center. Channels secured to joists at each intersection with two strands of 1.3 mm (No. 18 B.W. gage) galvanized wire	—	—	65	—	—	—	20	—
7. Reinforced concrete slabs and joists with hollow clay tile fillers laid end to end in rows 65 mm or more apart; reinforcement placed between rows and concrete cast around and over tile.	7-1.1	16 mm gypsum plaster on bottom of floor or roof construction	—	—	200 <sup>h</sup>	—	—	—	16	—
	7-1.2	None	—	—	—	140 <sup>i</sup>	—	—	—	—
8. Steel joists constructed with a reinforced concrete slab on top poured on a 13 mm deep steel deck. <sup>e</sup>	8-1.1	Vermiculite gypsum plaster on metal lath attached to 20 mm cold-rolled channels with 1.3 mm (No. 18 B.W. gage) wire ties spaced 150 mm on center	65 <sup>j</sup>	—	—	—	20	—	—	—
9. 75 mm deep cellular steel deck with concrete slab on top. Slab thickness measured to top.	9-1.1	Suspended ceiling of vermiculite gypsum plaster base coat and vermiculite acoustical plaster on metal lath attached at 150 mm intervals to 20 mm cold-rolled channels spaced 305 mm on center and secured to 40 mm cold-rolled channels spaced 915 mm on center with 1.6 mm (No. 16 B.W. gage) wire. 40 mm channels supported by 4.2 mm (No. 8 gage) wire hangers at 915 mm on center. Beams within envelope and with a 65 mm airspace between beam soffit and lath have a 4-hour rating	65	—	—	—	30 <sup>k</sup>	—	—	—
10. 40 mm-deep steel roof deck on steel framing. Insulation board, 480 kg/m <sup>3</sup> density, composed of wood fibers with cement binders of thickness shown bonded to deck with unified asphalt adhesive. Covered with a Class A or B roof covering.	10-1.1	Ceiling of gypsum plaster on metal lath. Lath attached to 20 mm furring channels with 1.3 mm (No. 18 B.W. gage) wire ties spaced 150 mm on center. 20 mm channel saddle tied to 50 mm channels with doubled 1.6 mm (No. 16 B.W. gage) wire ties. 50 mm channels spaced 915 mm on center suspended 50 mm below steel framing and saddle-tied with 4.2 mm (No. 8 B.W. gage) wire. Plaster mixed 1:2 by weight, gypsum-to-sand aggregate	—	—	50	25	—	—	20 <sup>l</sup>	20 <sup>l</sup>
11. 40 mm-deep steel roof deck on steel-framing wood fiber insulation board, 280 kg/m <sup>3</sup> density on top applied over a 7 kilogram asphalt-saturated felt. Class A or B roof covering.	11-1.1	Ceiling of gypsum plaster on metal lath. Lath attached to 20 mm furring channels with 1.3 mm (No. 18 B.W. gage) wire ties spaced 150 mm on center. 20 mm channels saddle tied to 50 mm channels with doubled 1.6 mm (No. 16 B.W. gage) wire ties. 50 mm channels spaced 915 mm on center suspended 50 mm below steel framing and saddle tied with 4.2 mm (No. 8 B.W. gage) wire. Plaster mixed 1:2 for scratch coat and 1:3 for brown coat, by weight, gypsum-to-sand aggregate for 1-hour system. For 2-hour system, plaster mix is 1:2 by weight, gypsum-to-sand aggregate	—	—	40	25	—	—	22 <sup>s</sup>	20 <sup>l</sup>

(Continued)

**TABLE 4B.20.1(3) – continued**  
**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS<sup>a, q</sup>**

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (mm)				MINIMUM THICKNESS OF CEILING (mm)			
			4 hour	3 hour	2 hour	1 hour	4 hour	3 hour	2 hour	1 hour
12.40 mm deep steel roof deck on steel-framing insulation of rigid board consisting of expanded perlite and fibers impregnated with integral asphalt waterproofing; density 145 to 195 kg/m <sup>3</sup> secured to metal roof deck by 13 mm wide ribbons of waterproof, cold-process liquid adhesive spaced 150 mm apart. Steel joist or light steel construction with metal roof deck, insulation, and Class A or B built-up roof covering. <sup>e</sup>	12-1.1	Gypsum-vermiculite plaster on metal lath wire tied at 150 mm intervals to 20 mm furring channels spaced 305 mm on center and wire tied to 50 mm runner channels spaced 815 mm on center. Runners wire tied to bottom chord of steel joists	—	—	25	—	—	—	22	—
13. Double wood floor over wood joists spaced 405 mm on center. <sup>m,n</sup>	13-1.1	Gypsum plaster over 10 mm Type X gypsum lath. Lath initially applied with not less than four 30 mm by No. 13 gage by 8 mm head plasterboard blued nails per bearing. Continuous stripping over lath along all joist lines. Stripping consists of 75 mm wide strips of metal lath attached by 40 mm by No. 11 gage by 13 mm head roofing nails spaced 150 mm on center. Alternate stripping consists of 75 mm wide 1.3 mm diameter wire stripping weighing 0.54 kilograms per square meter and attached by No.16 gage by 40 mm by 20 mm crown width staples, spaced 100 mm on center. Where alternate stripping is used, the lath nailing may consist of two nails at each end and one nail at each intermediate bearing. Plaster mixed 1:2 by weight, gypsum-to-sand aggregate	—	—	—	—	—	—	—	22
	13-1.2	Cement or gypsum plaster on metal lath. Lath fastened with 40 mm by No. 11 gage by 11 mm head barbed shank roofing nails spaced 125 mm on center. Plaster mixed 1:2 for scratch coat and 1:3 for brown coat, by weight, cement to sand aggregate	—	—	—	—	—	—	—	16
	13-1.3	Perlite or vermiculite gypsum plaster on metal lath secured to joists with 40 mm by No. 11 gage by 11 mm head barbed shank roofing nails spaced 125 mm on center	—	—	—	—	—	—	—	16
	13-1.4	13 mm Type X gypsum wallboard <sup>c</sup> nailed to joists with 5d cooler <sup>o</sup> or wallboard <sup>o</sup> nails at 150 mm on center. End joints of wallboard centered on joists	—	—	—	—	—	—	—	13
14. Plywood stressed skin panels consisting of 16 mm-thick interior C-D (exterior glue) top stressed skin on 50 mm × 150 mm nominal (minimum) stringers. Adjacent panel edges joined with 8d common wire nails spaced 150 mm on center. Stringers spaced 305 mm maximum on center.	14-1.1	13 mm-thick wood fiberboard weighing 240 to 290 kilograms per cubic meter installed with long dimension parallel to stringers or 10 mm C-D (exterior glue) plywood glued and/or nailed to stringers. Nailing to be with 5d cooler <sup>o</sup> or wallboard <sup>o</sup> nails at 305 mm on center. Second layer of 13 mm Type X gypsum wallboard <sup>c</sup> applied with long dimension perpendicular to joists and attached with 8d cooler <sup>o</sup> or wallboard <sup>o</sup> nails at 150 mm on center at end joints and 200 mm on center elsewhere. Wallboard joints staggered with respect to fiberboard joints	—	—	—	—	—	—	—	25

(Continued)

**TABLE 4B.20.1(3) – continued**  
**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS<sup>a, q</sup>**

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (mm)				MINIMUM THICKNESS OF CEILING (mm)			
			4 hour	3 hour	2 hour	1 hour	4 hour	3 hour	2 hour	1 hour
15. Vermiculite concrete slab proportioned 1:4 (Portland cement to vermiculite aggregate) on a 40 mm-deep steel deck supported on individually protected steel framing. Maximum span of deck 2.1 meter where deck is less than 0.5 mm (No. 26 carbon steel sheet gage) or greater. Slab reinforced with 100 × 200 mm 2.8/2.1 mm (No. 12/14 B.W. gage) welded wire mesh.	15-1.1	None	—	—	—	75 <sup>j</sup>	—	—	—	—
16. Perlite concrete slab proportioned 1:6 (portland cement to perlite aggregate) on a 32 mm-deep steel deck supported on individually protected steel framing. Slab reinforced with 100 × 200 mm 2.8/2.1 mm (No. 12/14 B.W. gage) welded wire mesh.	16-1.1	None	—	—	—	90 <sup>j</sup>	—	—	—	—
17. Perlite concrete slab proportioned 1:6 (portland cement to perlite aggregate) on a 14 mm-deep steel deck supported by steel joists 1.22 m on center. Class A or B roof covering on top.	17-1.1	Perlite gypsum plaster on metal lath wire tied to 20 mm furring channels attached with 1.6 mm (No. 16 B.W. gage) wire ties to lower chord of joists	—	50 <sup>p</sup>	50 <sup>p</sup>	—	—	22	20	—
18. Perlite concrete slab proportioned 1:6 (portland cement to perlite aggregate) on 32 mm-deep steel deck supported on individually protected steel framing. Maximum span of deck 2.1 meter where deck is less than 0.5 mm (No. 26 carbon sheet steel gage) and 2.4 meter where deck is 0.5 mm (No. 26 carbon sheet steel gage) or greater. Slab reinforced with 1.1 mm (No. 19 B.W. gage) hexagonal wire mesh. Class A or B roof covering on top.	18-1.1	None	—	60 <sup>p</sup>	60 <sup>p</sup>	—	—	—	—	—
19. Floor and beam construction consisting of 75 mm-deep cellular steel floor unit mounted on steel members with 1:4 (proportion of portland cement to perlite aggregate) perlite-concrete floor slab on top.	19-1.1	Suspended envelope ceiling of perlite gypsum plaster on metal lath attached to 20 mm cold-rolled channels, secured to 40 mm cold-rolled channels spaced 1.07 m on center supported by 5.2 mm (No. 6 B.W. gage) wire 915 mm on center. Beams in envelope with 75 mm minimum airspace between beam soffit and lath have a 4-hour rating	50 <sup>p</sup>	—	—	—	25 <sup>l</sup>	—	—	—

(Continued)

**TABLE 4B.20.1(3) – continued**  
**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS<sup>a, q</sup>**

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (mm)				MINIMUM THICKNESS OF CEILING (mm)			
			4 hour	3 hour	2 hour	1 hour	4 hour	3 hour	2 hour	1 hour
20. Perlite concrete proportioned 1:6 (portland cement to perlite aggregate) poured to 3 mm thickness above top of corrugations of 35 mm-deep galvanized steel deck maximum span 2.4 meter for 0.6-mm (No. 24 galvanized sheet gage) or 2.1 meter for 0.5-mm (No. 26 galvanized sheet gage) with deck supported by individually protected steel framing. Approved polystyrene foam plastic insulation board having a flame spread not exceeding 75 (25 mm to 100 mm thickness) with vent holes that approximate 3 percent of the board surface area placed on top of perlite slurry. A 0.61 m by 1.22 m insulation board contains six 70 mm diameter holes. Board covered with 60 mm minimum perlite concrete slab.	20-1.1	None	—	—	Varies	—	—	—	—	—
21. Slab reinforced with mesh consisting of 1.1 mm (No. 19 B.W. gage) galvanized steel wire twisted together to form 50 mm hexagons with straight 1.6 mm (No. 16 B.W. gage) galvanized steel wire woven into mesh and spaced 75 mm. Alternate slab reinforcement shall be permitted to consist of 100 mm × 200 mm, 2.8/2.1 mm (No. 12/4 B.W. gage), or 50 mm × 50 mm, 2.1/2.1-mm (No. 14/14 B.W. gage) welded wire fabric. Class A or B roof covering on top.	21-1.1	None	—	—	Varies	—	—	—	—	—
22. Wood joists, floor trusses and flat or pitched roof trusses spaced a maximum 610 mm o.c. with 13 mm wood structural panels with exterior glue applied at right angles to top of joist or top chord of trusses with 8d nails. The wood structural panel thickness shall not be less than nominal 13 mm.	22-1.1	Base layer 16 mm Type X gypsum wallboard applied at right angles to joist or truss 610 mm o.c. with 32 mm Type S or Type W drywall screws 610 mm o.c. Face layer 16 mm Type X gypsum wallboard or veneer base applied at right angles to joist or truss through base layer with 50 mm Type S or Type W drywall screws 305 mm o.c. at joints and intermediate joist or truss. Face layer Type G drywall screws placed 50 mm back on either side of face layer end joints, 305 mm o.c.	—	—	—	Varies	—	—	—	32

(Continued)



**TABLE 4B.20.1(3) – continued**  
**MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS<sup>a,q</sup>**

FLOOR OR ROOF CONSTRUCTION	ITEM NUMBER	CEILING CONSTRUCTION	THICKNESS OF FLOOR OR ROOF SLAB (mm)				MINIMUM THICKNESS OF CEILING (mm)			
			4 hour	3 hour	2 hour	1 hour	4 hour	3 hour	2 hour	1 hour
23. Steel joists, floor trusses and flat or pitched roof trusses spaced a maximum 610 mm o.c. with 13 mm wood structural panels with exterior glue applied at right angles to top of joist or top chord of trusses with No. 8 screws. The wood structural panel thickness shall not be less than nominal 13 mm nor less than required by SBC 306.	23-1.1	Base layer 16 mm Type X gypsum board applied at right angles to steel framing 610 mm on center with 25 mm Type S drywall screws spaced 610 mm on center. Face layer 16 mm Type X gypsum board applied at right angles to steel framing attached through base layer with 40 mm Type S drywall screws 305 mm on center at end joints and intermediate joints and 40 mm Type G drywall screws 305 mm on center placed 50 mm back on either side of face layer end joints. Joints of the face layer are offset 610 mm from the joints of the base layer	—	—	—	Varies	—	—	—	32
24. Wood I-joist (minimum joist depth 235 mm with a minimum flange depth of 35 mm and a minimum flange cross sectional area of 1,485 square millimeters) at 610 mm o.c. spacing with 1 × 4 (nominal) wood furring strip spacer applied parallel to and covering the bottom of the bottom flange of each member, tacked in place. 50 mm mineral fiber insulation, 56 kg/m <sup>3</sup> (nominal) installed adjacent to the bottom flange of the I-joist and supported by the 1 × 4 furring strip spacer.	24-1.1	13 mm deep single leg resilient channel 405 mm on center (channels doubled at wallboard end joints), placed perpendicular to the furring strip and joist and attached to each joist by 50 mm Type S drywall screws. 16 mm Type C gypsum wallboard applied perpendicular to the channel with end joints staggered at least 1.22 m and fastened with 30 mm Type S drywall screws spaced 175 mm on center. Wallboard joints to be taped and covered with joint compound	—	—	—	Varies	—	—	—	—

- a. Staples with equivalent holding power and penetration shall be permitted to be used as alternate fasteners to nails for attachment to wood framing.
- b. When the slab is in an unrestrained condition, minimum reinforcement cover shall not be less than 40 mm for 4-hour (siliceous aggregate only); 32 mm for 4- and 3-hour; 25 mm for 2-hour (siliceous aggregate only); and 20 mm for all other restrained and unrestrained conditions.
- c. For all of the construction with gypsum wallboard described in this table, gypsum base for veneer plaster of the same size, thickness and core type shall be permitted to be substituted for gypsum wallboard, provided attachment is identical to that specified for the wallboard, and the joints on the face layer are reinforced and the entire surface is covered with a minimum of 1.6 mm gypsum veneer plaster.
- d. Slab thickness over steel joists measured at the joists for metal lath form and at the top of the form for steel form units.
- e. (a) The maximum allowable stress level for H-Series joists shall not exceed 151,690 kPa.  
(b) The allowable stress for K-Series joists shall not exceed 179,270 kPa, the nominal depth of such joist shall not be less than 250 mm and the nominal joist weight shall not be less than 7.5 kg/m.
- f. Cement plaster with 7 kilograms of hydrated lime and 1.4 kilograms of approved additives or admixtures per bag of cement.
- g. Gypsum wallboard ceilings attached to steel framing shall be permitted to be suspended with 40 mm cold-formed carrying channels spaced 1.22 m on center, which are suspended with No. 8 SWG galvanized wire hangers spaced 1.22 m on center. Cross-furring channels are tied to the carrying channels with No. 18 SWG galvanized wire hangers spaced 1.22 m on center. Cross-furring channels are tied to the carrying channels with No. 18 SWG galvanized wire (double strand) and spaced as required for direct attachment to the framing. This alternative is also applicable to those steel framing assemblies recognized under Note q.
- h. Six-inch hollow clay tile with 50 mm concrete slab above.
- i. Four-inch hollow clay tile with 40 mm concrete slab above.
- j. Thickness measured to bottom of steel form units.
- k. Five-eighths inch of vermiculite gypsum plaster plus 13 mm of approved vermiculite acoustical plastic.
- l. Furring channels spaced 305 mm on center.
- m. Double wood floor shall be permitted to be either of the following:  
(a) Subfloor of 25 mm nominal boarding, a layer of asbestos paper weighing not less than 6.4 kilograms per 9.3 square meters and a layer of 25 mm nominal tongue-and-groove finished flooring; or  
(b) Subfloor of 25 mm nominal tongue-and-groove boarding or 12 mm wood structural panels with exterior glue and a layer of 25 mm nominal tongue-and-groove finished flooring or 15 mm wood structural panel finish flooring or a layer of Type I Grade M-1 particleboard not less than 16 mm thick.
- n. The ceiling shall be permitted to be omitted over unusable space, and flooring shall be permitted to be omitted where unusable space occurs above.
- o. For properties of cooler or wallboard nails, see ASTM C 514, ASTM C 547 or ASTM F 1667.
- p. Thickness measured on top of steel deck unit.
- q. Generic fire-resistance ratings those not designated as PROPRIETARY in the listing in the GA 600 shall be accepted as if herein listed.



- 4B.21.2 Concrete assemblies.** The provisions of this section contain procedures by which the fire-resistance ratings of concrete assemblies are established by calculations.
- 4B.21.2.1 Concrete walls.** Cast-in-place and precast concrete walls shall comply with Section 4B.21.2.1.1. Multiwythe concrete walls shall comply with Section 4B.21.2.1.2. Joints between precast panels shall comply with Section 4B.21.2.1.3. Concrete walls with gypsum wallboard or plaster finish shall comply with Section 4B.21.2.1.4.
- 4B.21.2.1.1 Cast-in-place or precast walls.** The minimum equivalent thicknesses of cast-in-place or precast concrete walls for fire-resistance ratings of 1 hour to 4 hours are shown in Table 4B.21.2.1.1. For solid walls with flat vertical surfaces, the equivalent thickness is the same as the actual thickness. The values in Table 4B.21.2.1.1 apply to plain, reinforced or prestressed concrete walls.

**TABLE 4B.21.2.1.1  
MINIMUM EQUIVALENT THICKNESS OF CAST-IN-PLACE OR  
PRECAST CONCRETE WALLS, LOAD-BEARING OR NONLOAD-  
BEARING**

CONCRETE TYPE	MINIMUM WALL THICKNESS (mm) FOR FIRE-RESISTANCE RATING OF				
	1-hour	1 ½ -hour	2-hour	3-hour	4-hour
Siliceous	90	110	125	160	175
Carbonate	80	100	115	145	170
Sand-Lightweight	70	85	95	115	135
Lightweight	65	80	90	110	130

- 4B.21.2.1.1.1 Hollow-core precast wall panels.** For hollow-core precast concrete wall panels in which the cores are of constant cross section throughout the length, calculation of the equivalent thickness by dividing the net cross-sectional area (the gross cross section minus the area of the cores) of the panel by its width shall be permitted.
- 4B.21.2.1.1.2 Core spaces filled.** Where all of the core spaces of hollow-core wall panels are filled with loose-fill material, such as expanded shale, clay, or slag, or vermiculite or perlite, the fire-resistance rating of the wall is the same as that of a solid wall of the same concrete type and of the same overall thickness.
- 4B.21.2.1.1.3 Tapered cross sections.** The thickness of panels with tapered cross sections shall be that determined at a distance  $2t$  or 150 mm, whichever is less, from the point of minimum thickness, where  $t$  is the minimum thickness.
- 4B.21.2.1.1.4 Ribbed or undulating surfaces.** The equivalent thickness of panels with ribbed or undulating surfaces shall be determined by one of the following expressions:

For  $s \geq 4t$ , the thickness to be used shall be  $t$

For  $s \leq 2t$ , the thickness to be used shall be  $t_e$

For  $4t > s > 2t$ , the thickness to be used shall be

$$t + \left( \frac{4t}{s} - 1 \right) (t_e - t) \quad \text{(Equation 4B.-3)}$$

Where:

$s$  = Spacing of ribs or undulations.

$t$  = Minimum thickness.

$t_e$  = Equivalent thickness of the panel calculated as the net cross-sectional area of the panel divided by the width, in which the maximum thickness used in the calculation shall not exceed  $2t$ .

**4B.21.2.1.2 Multiwythe walls.** For walls that consist of two wythes of different types of concrete, the fire-resistance ratings shall be permitted to be determined from Figure 4B.21.2.1.2.

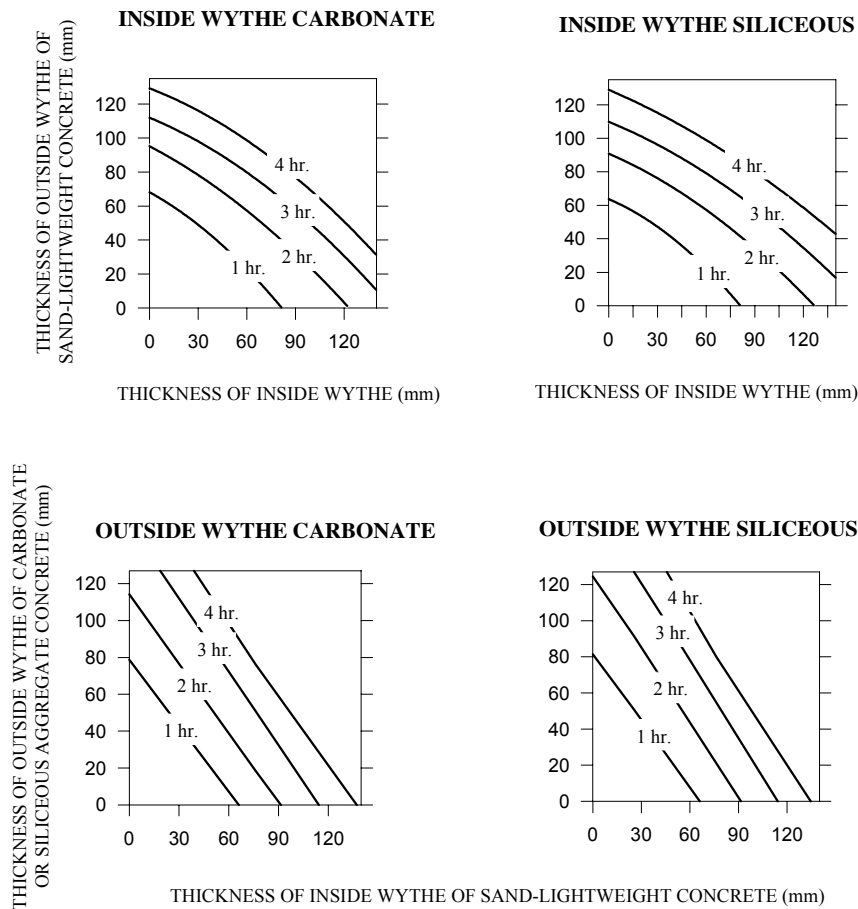
**4B.21.2.1.2.1 Two or more wythes.** The fire-resistance rating for wall panels consisting of two or more wythes shall be permitted to be determined by the formula:

$$R = (R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59})^{1.7} \quad \text{(Equation 4B.-4)}$$

Where:

$R$  = The fire endurance of the assembly, minutes.

$R_1, R_2,$  and  $R_n$  = The fire endurences of the individual wythes, minutes. Values of  $R_n^{0.59}$  for use in Equation 4B.-4 are given in Table 4B.21.2.1.2(1). Calculated fire-resistance ratings are shown in Table 4B.21.2.1.2(2).



**FIGURE 4B.21.2.1.2**  
**FIRE-RESISTANCE RATINGS OF TWO-WYTHER CONCRETE WALLS**

**TABLE 4B.21.2.1.2(1)**  
**VALUES OF  $R_n^{0.59}$  FOR USE IN EQUATION 4B.-4**

TYPE OF MATERIAL	THICKNESS OF MATERIAL (mm)											
	40	50	65	75	90	100	115	125	140	150	165	175
Siliceous aggregate concrete	5.3	6.5	8.1	9.5	11.3	13.0	14.9	16.9	18.8	20.7	22.8	25.1
Carbonate aggregate concrete	5.5	7.1	8.9	10.4	12.0	14.0	16.2	18.1	20.3	21.9	24.7	27.2 <sup>c</sup>
Sand-lightweight concrete	6.5	8.2	10.5	12.8	15.5	18.1	20.7	23.3	26.0 <sup>c</sup>	Note c	Note c	Note c
Lightweight concrete	6.6	8.8	11.2	13.7	16.5	19.1	21.9	24.7	27.8 <sup>c</sup>	Note c	Note c	Note c
Insulating concrete <sup>a</sup>	9.3	13.3	16.6	18.3	23.1	26.5 <sup>c</sup>	Note c	Note c	Note c	Note c	Note c	Note c
Airspace <sup>b</sup>	—	—	—	—	—	—	—	—	—	—	—	—

a. Dry unit weight of 560 kg/m<sup>3</sup> or less and consisting of cellular, perlite or vermiculite concrete.

b. The  $R_n^{0.59}$  value for 40 mm to 90 mm airspace is 3.3. The  $R_n^{0.59}$  value for 65 mm to 90 mm airspaces is 6.7.

c. The fire-resistance rating for this thickness exceeds 4 hours.

**TABLE 4B.21.2.1.2(2)**  
**FIRE-RESISTANCE RATINGS BASED ON  $R^{0.59}$**

$R^a$ , MINUTES	$R^{0.59}$
60	11.20
120	16.85
180	21.41
240	25.37

a. Based on Equation 4B.4

**4B.21.2.1.2.2 Foam plastic insulation.** The fire-resistance ratings of precast concrete wall panels consisting of a layer of foam plastic insulation sandwiched between two wythes of concrete shall be permitted to be determined by use of Equation 4B.-4. Foam plastic insulation with a total thickness of less than 25 mm shall be disregarded. The  $R_n$  value for thickness of foam plastic insulation of 25 mm or greater, for use in the calculation, is 5 minutes; therefore  $R_n^{0.59} = 2.5$ .

**4B.21.2.1.3 Joints between precast wall panels.** Joints between precast concrete wall panels which are not insulated as required by this section shall be considered as openings in walls. Uninsulated joints shall be included in determining the percentage of openings permitted by Table 4B.4.8. Where openings are not permitted or are required by these code requirements to be protected, the provisions of this section shall be used to determine the amount of joint insulation required. Insulated joints shall not be considered openings for purposes of determining compliance with the allowable percentage of openings in Table 4B.4.8.

**4B.21.2.1.3.1 Ceramic fiber joint protection.** Figure 4B.21.2.1.3.1 shows thicknesses of ceramic fiber blankets to be used to insulate joints between precast concrete wall panels for various panel thicknesses and for joint widths of 10 mm and 25 mm for fire-resistance ratings of 1 hour to 4 hours. For joint widths between 10 mm and 25 mm, the thickness of ceramic fiber blanket is allowed to be determined by direct interpolation. Other tested and labeled materials are acceptable in place of ceramic fiber blankets.

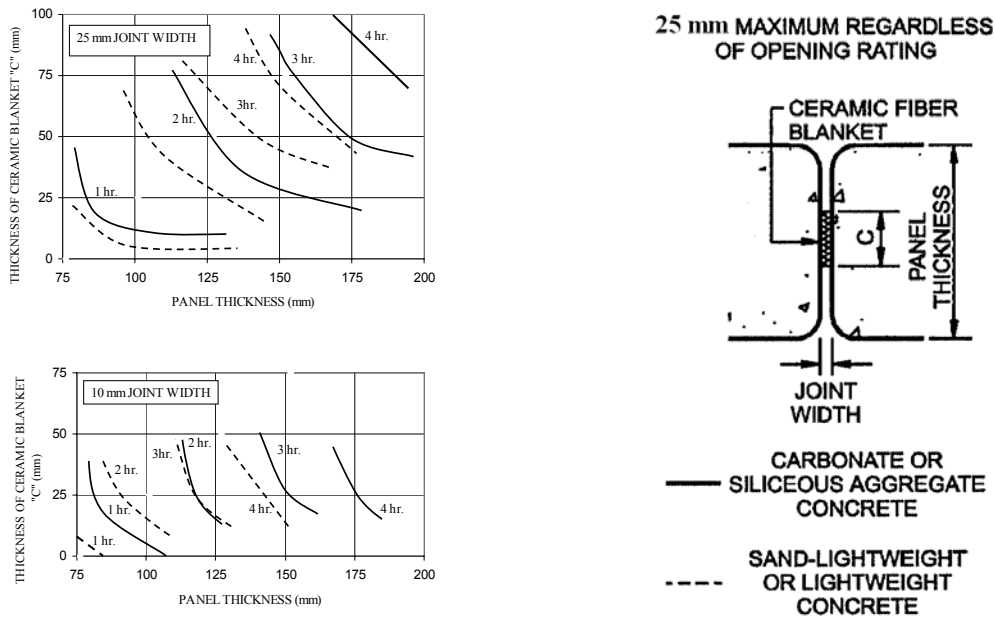


FIGURE 4B.21.2.1.3.1  
CERAMIC FIBER JOINT PROTECTION

**4B.21.2.1.4 Walls with gypsum wallboard or plaster finishes.** The fire-resistance rating of cast-in-place or precast concrete walls with finishes of gypsum wallboard or plaster applied to one or both sides shall be permitted to be calculated in accordance with the provisions of this section.

**4B.21.2.1.4.1 Nonfire-exposed side.** Where the finish of gypsum wallboard or plaster is applied to the side of the wall not exposed to fire, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The thickness of the finish shall first be corrected by multiplying the actual thickness of the finish by the applicable factor determined from Table 4B.21.2.1.4(1) based on the type of aggregate in the concrete. The corrected thickness of finish shall then be added to the actual or equivalent thickness of concrete and fire-resistance rating of the concrete and finish determined from Table 4B.21.2.1.1, Figure 4B.21.2.1.2 or Table 4B.21.2.1.2(1).

**4B.21.2.1.4.2 Fire-exposed side.** Where gypsum wallboard or plaster is applied to the fire-exposed side of the wall, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The time assigned to the finish as established by Table 4B.21.2.1.4(2) shall be added to the fire-resistance rating determined from Table 4B.21.2.1.1 or Figure 4B.21.2.1.2, or Table 4B.21.2.1.2(1) for the concrete alone, or to the rating determined in Section 4B.21.2.1.4.1 for the concrete and finish on the nonfire-exposed side.

**4B.21.2.1.4.3 Nonsymmetrical assemblies.** For a wall having no finish on one side or different types or thicknesses of finish on each side, the calculation procedures of Sections 4B.21.2.1.4.1 and 4B.21.2.1.4.2 shall be performed twice, assuming either side of the wall to be the fire-exposed side. The fire-resistance rating of the wall shall not exceed the lower of the two values.

**Exception:** For an exterior wall with more than 1.5 m of horizontal separation, the fire shall be assumed to occur on the interior side only.

**TABLE 4B.21.2.1.4(1)**  
**MULTIPLYING FACTOR FOR FINISHES ON NONFIRE-EXPOSED SIDE OF WALL**

TYPE OF FINISH APPLIED TO MASONRY WALL	TYPE OF AGGREGATE USED IN CONCRETE OR CONCRETE MASONRY			
	Concrete: siliceous or carbonate Masonry: siliceous or calcareous gravel	Concrete: sand lightweight concrete Masonry: limestone, cinders or unexpected slag	Concrete: light-weight concrete Masonry: expanded shale, clay or slate	Concrete: pumice, or expanded slag
Portland cement-sand plaster	1.00	0.75 <sup>a</sup>	0.75 <sup>a</sup>	0.50 <sup>a</sup>
Gypsum-sand plaster or gypsum wallboard	1.25	1.00	1.00	1.00
Gypsum-vermiculite or perlite plaster	1.75	1.50	1.50	1.25

- a. For Portland cement-sand plaster 16 mm or less in thickness and applied directly to the masonry on the nonfire-exposed side of the wall, the multiplying factor shall be 1.00.

**4B.21.2.1.4.4 Minimum concrete fire-resistance rating.** Where finishes applied to one or both sides of a concrete wall contribute to the fire-resistance rating, the concrete alone shall provide not less than one-half of the total required fire-resistance rating. Additionally, the contribution to the fire resistance of the finish on the nonfire-exposed side of a load-bearing wall shall not exceed one-half the contribution of the concrete alone.

**4B.21.2.1.4.5 Concrete finishes.** Finishes on concrete walls that are assumed to contribute to the total fire-resistance rating of the wall shall comply with the installation requirements of Section 4B.21.3.2.5.

**4B.21.2.2 Concrete floor and roof slabs.** Reinforced and prestressed floors and roofs shall comply with Section 4B.21.2.2.1. Multicourse floors and roofs shall comply with Sections 4B.21.2.2.2 and 4B.21.2.2.3, respectively.

**4B.21.2.2.1 Reinforced and prestressed floors and roofs.** The minimum thicknesses of reinforced and prestressed concrete floor or roof slabs for fire-resistance ratings of 1 hour to 4 hours are shown in Table 4B.21.2.2.1.

**TABLE 4B.21.2.1.4(2)**  
**TIME ASSIGNED TO FINISH MATERIALS ON FIRE-EXPOSED SIDE OF WALL**

FINISH DESCRIPTION	TIME (minute)
Gypsum wallboard	
10 mm	10
13 mm	15
16 mm	20
2 layers of 10 mm	25
1 layer 10 mm, 1 layer 13 mm	35
2 layers 13 mm	40
Type X gypsum wallboard	
13 mm	25
16 mm	40
Portland cement-sand plaster applied directly to concrete masonry	See Note a
Portland cement-sand plaster on metal lath	
20 mm	20
22 mm	25
25 mm	30
Gypsum sand plaster on 10 mm gypsum lath	
13 mm	35
16 mm	40
20 mm	50
Gypsum sand plaster on metal lath	
20 mm	50
22 mm	60
25 mm	80

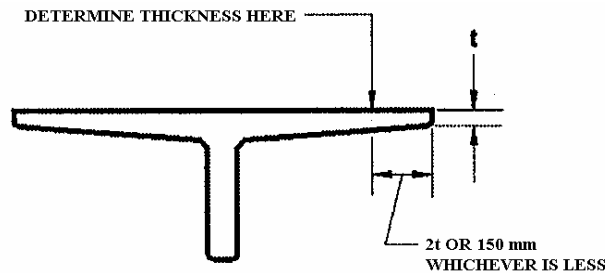
- a. The actual thickness of Portland cement-sand plaster, provided it is 16 mm or less in thickness, shall be permitted to be included in determining the equivalent thickness of the masonry for use in Table 4B.21.3.2.

**TABLE 4B.21.2.2.1**  
**MINIMUM SLAB THICKNESS (mm)**

CONCRETE TYPE	FIRE-RESISTANCE RATING (hour)				
	1	1 ½	2	3	4
Siliceous	90	110	125	160	175
Carbonate	80	100	115	145	170
Sand-lightweight	70	85	95	115	135
Lightweight	65	80	90	110	130

**4B.21.2.2.1.1 Hollow-core prestressed slabs.** For hollow-core prestressed concrete slabs in which the cores are of constant cross section throughout the length, the equivalent thickness shall be permitted to be obtained by dividing the net cross-sectional area of the slab including grout in the joints, by its width.

**4B.21.2.2.1.2 Slabs with sloping soffits.** The thickness of slabs with sloping soffits (see Figure 4B.21.2.2.1.2) shall be determined at a distance  $2t$  or 150 mm, whichever is less, from the point of minimum thickness, where  $t$  is the minimum thickness.



**FIGURE 4B.21.2.2.1.2**  
**DETERMINATION OF SLAB**  
**THICKNESS FOR SLOPING SOFFITS**

**4B.21.2.2.1.3 Slabs with ribbed soffits.** The thickness of slabs with ribbed or undulating soffits (see Figure 4B.21.2.2.1.3) shall be determined by one of the following expressions, whichever is applicable:

For  $s \geq 4t$ , the thickness to be used shall be  $t$

For  $s \leq 2t$ , the thickness to be used shall be  $t_e$

For  $4t > s > 2t$ , the thickness to be used shall be

$$t + \left( \frac{4t}{s} - 1 \right) (t_e - t) \quad \text{(Equation 4B.-5)}$$

Where:

$s$  = Spacing of ribs or undulations.

$t$  = Minimum thickness.

$t_e$  = Equivalent thickness of the slab calculated as the net area of the slab divided by the width, in which the maximum thickness used in the calculation shall not exceed  $2t$ .

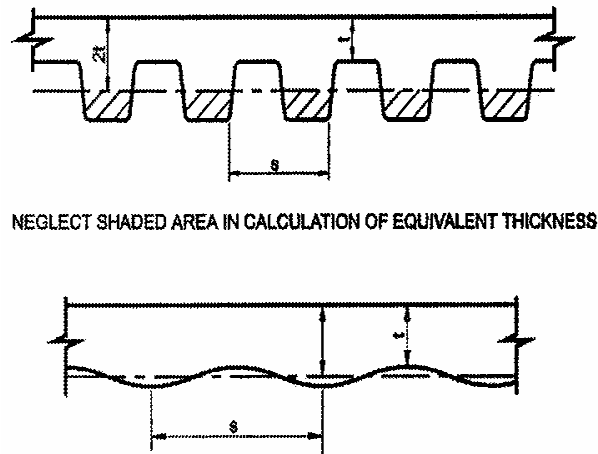
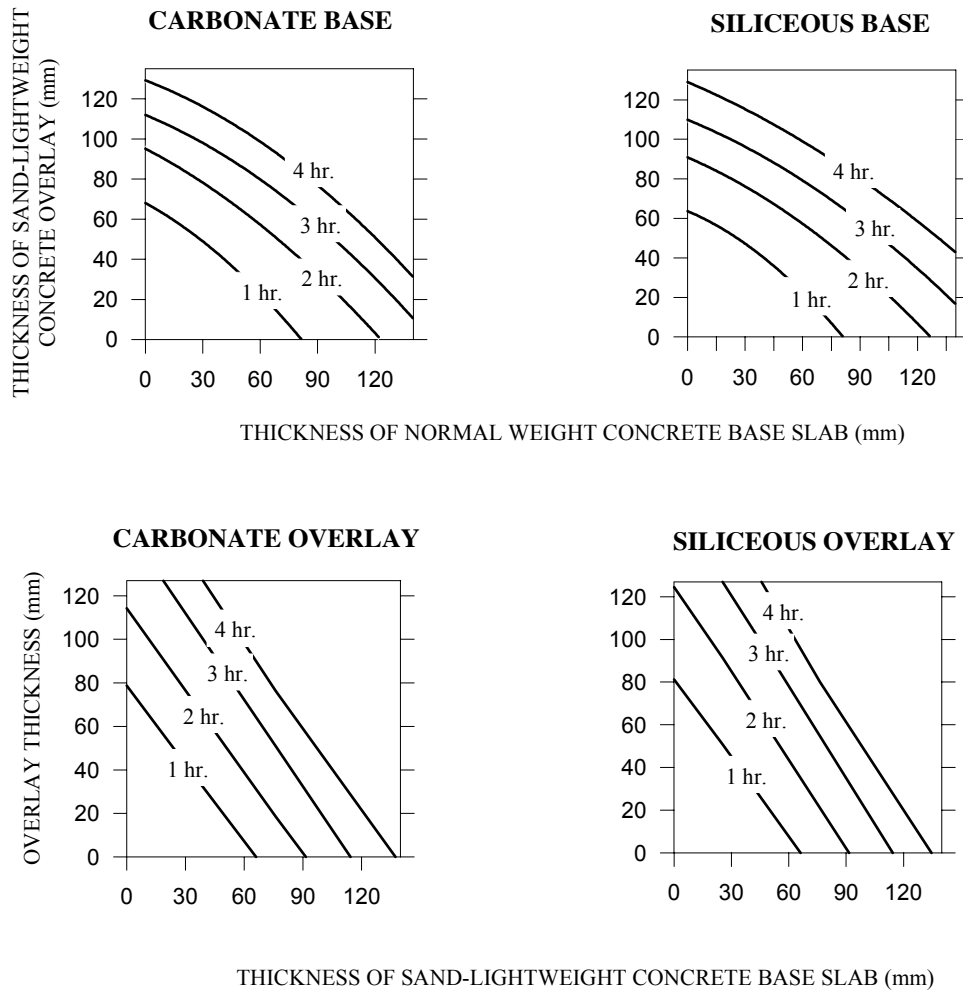


FIGURE 4B.21.2.2.1.3  
SLABS WITH RIBBED OR UNDULATING SOFFITS

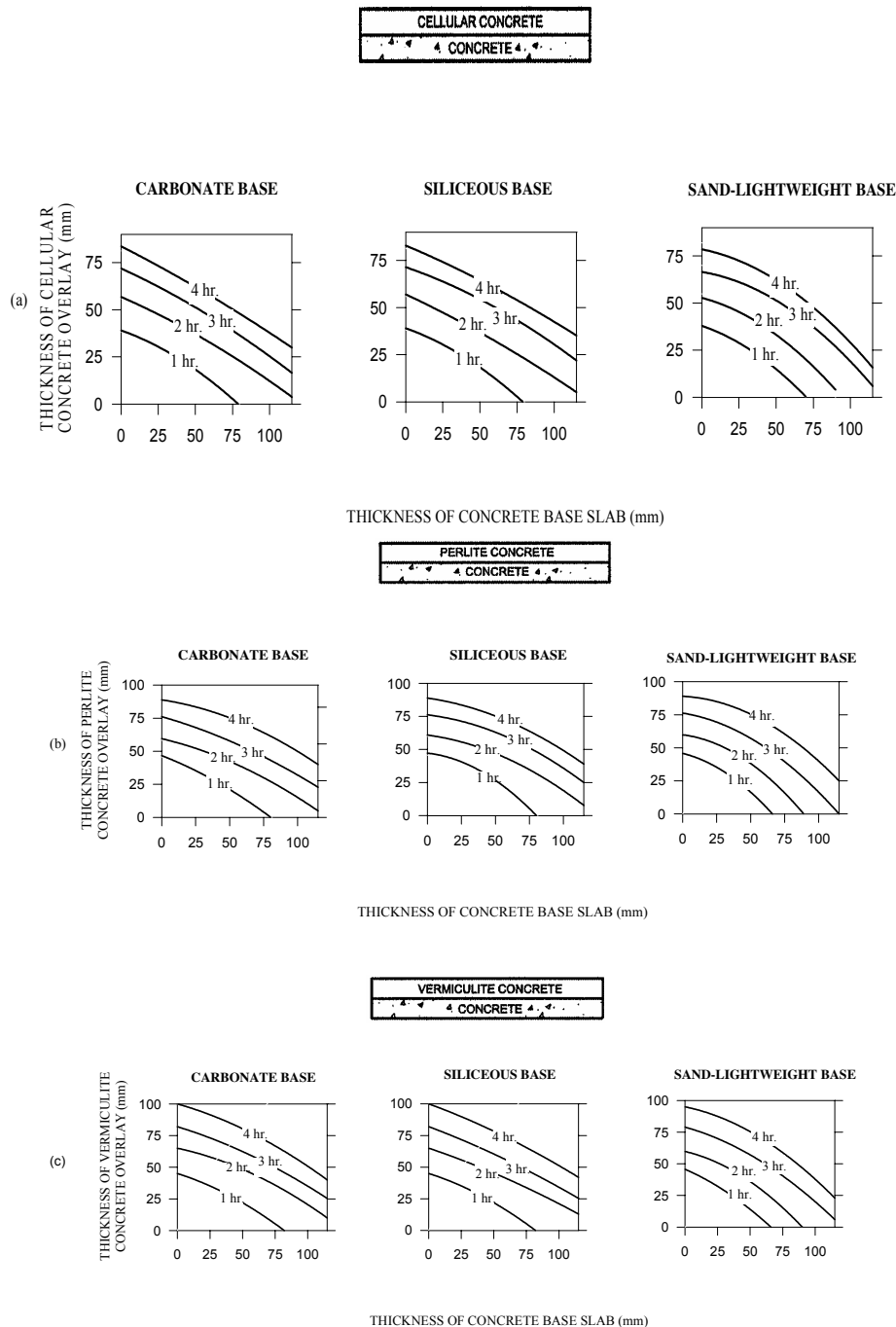
- 4B.21.2.2.2 Multicourse floors.** The fire-resistance ratings of floors that consist of a base slab of concrete with a topping (overlay) of a different type of concrete shall comply with Figure 4B.21.2.2.2.
- 4B.21.2.2.3 Multicourse roofs.** The fire-resistance ratings of roofs which consist of a base slab of concrete with a topping (overlay) of an insulating concrete or with an insulating board and built-up roofing shall comply with Figures 4B.21.2.2.3(1) and 4B.21.2.2.3(2).
- 4B.21.2.2.3.1 Heat transfer.** For the transfer of heat, three-ply built-up roofing contributes 10 minutes to the fire-resistance rating. The fire-resistance rating for concrete assemblies such as those shown in Figure 4B.21.2.2.3(1) shall be increased by 10 minutes. This increase is not applicable to those shown in Figure 4B.21.2.2.3(2).
- 4B.21.2.2.4 Joints in precast slabs.** Joints between adjacent precast concrete slabs need not be considered in calculating the slab thickness provided that a concrete topping at least 25 mm thick is used. Where no concrete topping is used, joints must be grouted to a depth of at least one-third the slab thickness at the joint, but not less than 25 mm, or the joints must be made fire resistant by other approved methods.
- 4B.21.2.3 Concrete cover over reinforcement.** The minimum thickness of concrete cover over reinforcement in concrete slabs, reinforced beams and prestressed beams shall comply with this section.
- 4B.21.2.3.1 Slab cover.** The minimum thickness of concrete cover to the positive moment reinforcement shall comply with Table 4B.21.2.3(1) for reinforced concrete and Table 4B.21.2.3(2) for prestressed concrete. These tables are applicable for solid or hollow-core one-way or two-way slabs with flat undersurfaces. These tables are applicable to slabs that are either cast in place or precast. For precast prestressed concrete not covered elsewhere, the procedures contained in PCI MNL 124 shall be acceptable.
- 4B.21.2.3.2 Reinforced beam cover.** The minimum thickness of concrete cover to the positive moment reinforcement (bottom steel) for reinforced concrete beams is shown in Table 4B.21.2.3(3) for fire-resistance ratings of 1 hour to 4 hours.
- 4B.21.2.3.3 Prestressed beam cover.** The minimum thickness of concrete cover to the positive moment prestressing tendons (bottom steel) for restrained and unrestrained prestressed concrete beams and stemmed units shall comply with the values shown in Tables 4B.21.2.3(4) and 4B.21.2.3(5) for fire-resistance ratings of 1 hour to 4 hours. Values in Table 4B.21.2.3(4) apply to beams 200 mm or greater in width. Values in Table 4B.21.2.3(5) apply to beams or stems of any width,

provided the cross-section area is not less than 25,810 mm<sup>2</sup>. In case of differences between the values determined from Table 4B.21.2.3(4) or 4B.21.2.3(5), it is permitted to use the smaller value. The concrete cover shall be calculated in accordance with Section 4B.21.2.3.3.1. The minimum concrete cover for nonprestressed reinforcement in prestressed concrete beams shall comply with Section 4B.21.2.3.2.



**FIGURE 4B.21.2.2.2**  
**FIRE-RESISTANCE RATINGS FOR TWO-COURSE CONCRETE FLOORS**

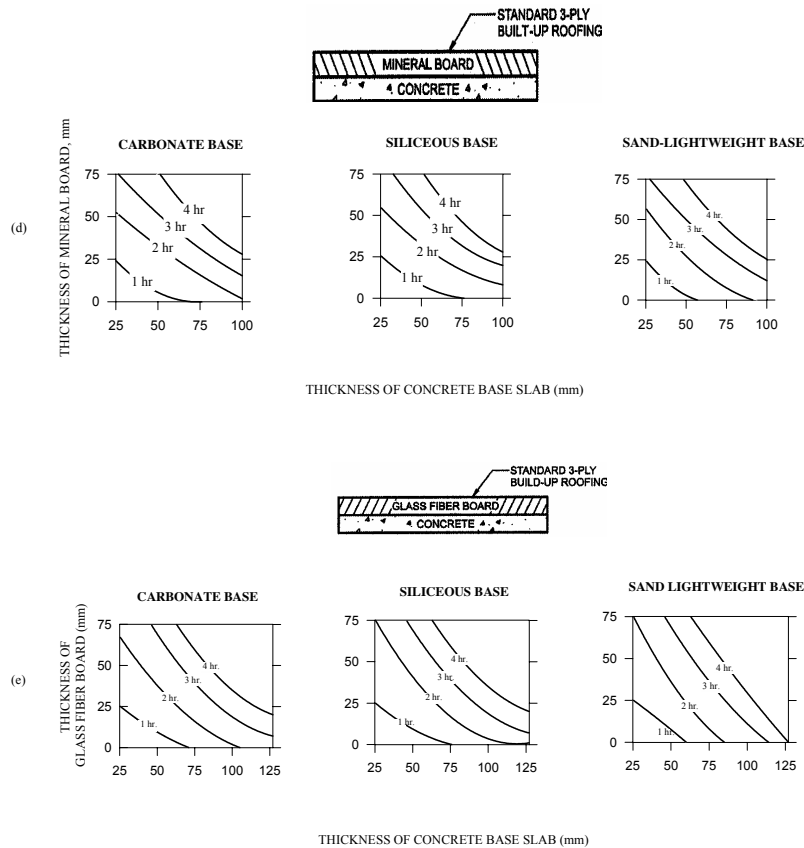




**FIGURE 4B.21.2.2.3(1)**  
**FIRE-RESISTANCE RATINGS FOR CONCRETE ROOF ASSEMBLIES**

**4B.21.2.3.3.1 Calculating concrete cover.** The concrete cover for an individual tendon is the minimum thickness of concrete between the surface of the tendon and the fire-exposed surface of the beam, except that for ungrouped ducts, the assumed cover thickness is the minimum thickness of concrete between the surface of the duct and the fire-exposed surface of the beam. For beams in which two or more tendons are used, the cover is assumed to be the average of the minimum cover of the individual tendons. For corner tendons (tendons equal distance from the bottom and side), the minimum cover used in the calculation shall be one-half the actual value. For stemmed members with two or more prestressing tendons located along the vertical centerline of the stem, the average cover shall be the distance from the

bottom of the member to the centroid of the tendons. The actual cover for any individual tendon shall not be less than one-half the smaller value shown in Tables 4B.21.2.3(4) and 4B.21.2.3(5), or 25 mm, whichever is greater.



**FIGURE 4B.21.2.2.3(2)**  
**FIRE-RESISTANCE RATINGS FOR CONCRETE ROOF ASSEMBLIES**

**TABLE 4B.21.2.3(1)**  
**COVER THICKNESS FOR REINFORCED CONCRETE FLOOR OR ROOF SLABS (mm)**

CONCRETE AGGREGATE TYPE	FIRE-RESISTANCE RATING (hours)									
	Restrained					Unrestrained				
	1	1 ½	2	3	4	1	1 ½	2	3	4
Siliceous	20	20	20	20	20	20	20	25	32	40
Carbonate	20	20	20	20	20	20	20	20	32	32
Sand-lightweight or lightweight	20	20	20	20	20	20	20	20	32	32

**TABLE 4B.21.2.3(2)**  
**COVER THICKNESS FOR PRESTRESSED CONCRETE FLOOR OR ROOF SLABS (mm)**

CONCRETE AGGREGATE TYPE	FIRE-RESISTANCE RATING (hours)									
	Restrained					Unrestrained				
	1	1 ½	2	3	4	1	1 ½	2	3	4
Siliceous	20	20	20	20	20	30	40	45	60	70
Carbonate	20	20	20	20	20	25	35	40	55	60
Sand-lightweight or lightweight	20	20	20	20	20	25	35	40	50	60

**TABLE 4B.21.2.3(3)**  
**MINIMUM COVER FOR MAIN REINFORCING BARS OF REINFORCED CONCRETE BEAMS<sup>c</sup>**  
**(APPLICABLE TO ALL TYPES OF STRUCTURAL CONCRETE)**

RESTRAINED OR UNRESTRAINED <sup>a</sup>	BEAM WIDTH <sup>b</sup> (mm)	FIRE-RESISTANCE RATING (hours)				
		1	1 ½	2	3	4
Restrained	125	20	20	20	25 <sup>a</sup>	32 <sup>a</sup>
	175	20	20	20	20	20
	≥ 250	20	20	20	20	20
Unrestrained	125	20	25	32	—	—
	175	20	20	20	45	75
	≥ 250	20	20	20	25	45

- a. Tabulated values for restrained assemblies apply to beams spaced more than 1.2 m on center. For restrained beams spaced 1.2 m or less on center, minimum cover of 20 mm is adequate for ratings of 4 hours or less.
- b. For beam widths between the tabulated values, the minimum cover thickness can be determined by direct interpolation.
- c. The cover for an individual reinforcing bar is the minimum thickness of concrete between the surface of the bar and the fire-exposed surface of the beam. For beams in which several bars are used, the cover for corner bars used in the calculation shall be reduced to one-half of the actual value. The cover for an individual bar must be not less than one-half of the value given in Table 4B.21.2.3(3) nor less than 20 mm.

**TABLE 4B.21.2.3(4)**  
**MINIMUM COVER FOR PRESTRESSED CONCRETE BEAMS 200 mm**  
**OR GREATER IN WIDTH**

RESTRAINED OR UNRESTRAINED <sup>a</sup>	CONCRETE AGGREGATE TYPE	BEAM WIDTH <sup>b</sup> (mm)	FIRE-RESISTANCE RATING (hours)				
			1	1 ½	2	3	4
Restrained	Carbonate or siliceous	200	40	40	40	45 <sup>a</sup>	65 <sup>a</sup>
	Carbonate or siliceous	≥ 305	40	40	40	40	50 <sup>a</sup>
	Sand lightweight	200	40	40	40	40	50 <sup>a</sup>
	Sand lightweight	≥ 305	40	40	40	40	40 <sup>a</sup>
Unrestrained	Carbonate or siliceous	200	40	45	65	125 <sup>c</sup>	—
	Carbonate or siliceous	≥ 305	40	40	50 <sup>a</sup>	65	75
	Sand lightweight	200	40	40	50	85	—
	Sand lightweight	≥ 305	40	40	40	50	65

- a. Tabulated values for restrained assemblies apply to beams spaced more than 1.2 m on center. For restrained beams spaced 1.2 m or less on center, minimum cover of 20 mm is adequate for 4-hour ratings or less.
- b. For beam widths between 200 mm and 305 mm, minimum cover thickness can be determined by direct interpolation.
- c. Not practical for 200 mm-wide beam but shown for purposes of interpolation.

**TABLE 4B.21.2.3(5)**  
**MINIMUM COVER FOR PRESTRESSED CONCRETE BEAMS OF ALL WIDTHS**

RESTRAINED OR UNRESTRAINED <sup>a</sup>	CONCRETE AGGREGATE TYPE	BEAM AREA <sup>b</sup> A (square mm)	FIRE-RESISTANCE RATING (hours)				
			1	1 ½	2	3	4
Restrained	All	$25,810 \leq A \leq 96,780$	40	40	50	65	—
	Carbonate or siliceous	$96,780 < A \leq 193,560$	40	40	40	45	65
		$193,560 < A$	40	40	40	40	50
	Sand lightweight	$96,780 < A$	40	40	40	40	50
Unrestrained	All	$25,810 \leq A \leq 96,780$	50	65	—	—	—
	Carbonate or siliceous	$96,780 < A \leq 193,560$	40	45	65	—	—
		$193,560 < A$	40	40	50	75 <sup>c</sup>	100 <sup>c</sup>
	Sand lightweight	$96,780 < A$	40	40	50	75 <sup>c</sup>	100 <sup>c</sup>

- Tabulated values for restrained assemblies apply to beams spaced more than 1.2 m on center. For restrained beams spaced 1.2 m or less on center, minimum cover of 20 mm is adequate for 4-hour ratings or less.
- The cross-sectional area of a stem is permitted to include a portion of the area in the flange, provided the width of the flange used in the calculation does not exceed three times the average width of the stem.
- U-shaped or hooped stirrups spaced not to exceed the depth of the member and having a minimum cover of 25 mm shall be provided.

**TABLE 4B.21.2.4**  
**MINIMUM DIMENSION OF CONCRETE COLUMNS (mm)**

TYPES OF CONCRETE	FIRE-RESISTANCE RATING (hours)				
	1	1 ½	2 <sup>a</sup>	3 <sup>a</sup>	4 <sup>b</sup>
Siliceous	200	230	250	305	355
Carbonate	200	230	250	280	305
Sand-lightweight	200	215	230	265	305

- The minimum dimension is permitted to be reduced to 200 mm for rectangular columns with two parallel sides at least 915 mm in length.
- The minimum dimension is permitted to be reduced to 250 mm for rectangular columns with two parallel sides at least 915 mm in length.

**4B.21.2.4 Concrete columns.** Concrete columns shall comply with this section.

**4B.21.2.4.1 Minimum size.** The minimum overall dimensions of reinforced concrete columns for fire-resistance ratings of 1 hour to 4 hours shall comply with Table 4B.21.2.4.

**4B.21.2.4.2 Minimum cover for R/C columns.** The minimum thickness of concrete cover to the main longitudinal reinforcement in columns, regardless of the type of aggregate used in the concrete, shall not be less than 25 mm times the number of hours of required fire resistance or 50 mm, whichever is less.

**4B.21.2.4.3 Columns built into walls.** The minimum dimensions of Table 4B.21.2.4 do not apply to a reinforced concrete column that is built into a concrete or masonry wall provided all of the following are met:

- The fire-resistance rating for the wall is equal to or greater than the required rating of the column;
- The main longitudinal reinforcing in the column has cover not less than that required by Section 4B.21.2.4.2; and
- Openings in the wall are protected in accordance with Table 4B.15.4.

Where openings in the wall are not protected as required by Section 4B.15.4, the minimum dimension of columns required to have a fire-resistance rating of 3 hours or less shall be 200 mm, and 250 mm for columns required to have a fire-

resistance rating of 4 hours, regardless of the type of aggregate used in the concrete.

**4B.21.2.4.4 Precast cover units for steel columns.** See Section 4B.21.5.1.4.

**4B.21.3 Concrete masonry.** The provisions of this section contain procedures by which the fire-resistance ratings of concrete masonry are established by calculations.

**4B.21.3.1 Equivalent thickness.** The equivalent thickness of concrete masonry construction shall be determined in accordance with the provisions of this section.

**4B.21.3.1.1 Concrete masonry unit plus finishes.** The equivalent thickness of concrete masonry assemblies,  $T_{ea}$ , shall be computed as the sum of the equivalent thickness of the concrete masonry unit,  $T_e$ , as determined by Section 4B.21.3.1.2, 4B.21.3.1.3, or 4B.21.3.1.4, plus the equivalent thickness of finishes,  $T_{ef}$ , determined in accordance with Section 4B.21.3.2:

$$T_{ea} = T_e + T_{ef} \quad \text{(Equation 4B.-6)}$$

$$T_e = V_n / LH = \text{Equivalent thickness of concrete masonry unit (mm).}$$

Where:

$V_n$  = Net volume of masonry unit ( $\text{mm}^3$ ).

$L$  = Specified length of masonry unit (mm).

$H$  = Specified height of masonry unit (mm).

**4B.21.3.1.2 UngROUTED or partially grouted construction.**  $T_e$  shall be the value obtained for the concrete masonry unit determined in accordance with ASTM C 140.

**4B.21.3.1.3 Solid grouted construction.** The equivalent thickness,  $T_e$ , of solid grouted concrete masonry units is the actual thickness of the unit.

**4B.21.3.1.4 Airspaces and cells filled with loose-fill material.** The equivalent thickness of completely filled hollow concrete masonry is the actual thickness of the unit when loose-fill materials are: sand, pea gravel, crushed stone, or slag that meet ASTM C 33 requirements; pumice, scoria, expanded shale, expanded clay, expanded slate, expanded slag, expanded fly ash, or cinders that comply with ASTM C 331; or perlite or vermiculite meeting the requirements of ASTM C 549 and ASTM C 516, respectively.

**4B.21.3.2 Concrete masonry walls.** The fire-resistance rating of walls and partitions constructed of concrete masonry units shall be determined from Table 4B.21.3.2. The rating shall be based on the equivalent thickness of the masonry and type of aggregate used.

**4B.21.3.2.1 Finish on nonfire-exposed side.** Where plaster or gypsum wallboard is applied to the side of the wall not exposed to fire, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The thickness of gypsum wallboard or plaster shall be corrected by multiplying the actual thickness of the finish by applicable factor determined from Table 4B.21.2.1.4(1). This corrected thickness of finish shall be added to the equivalent thickness of masonry and the fire-resistance rating of the masonry and finish determined from Table 4B.21.3.2.

**4B.21.3.2.2 Finish on fire-exposed side.** Where plaster or gypsum wallboard is applied to the fire-exposed side of the wall, the contribution of the finish to the total fire-resistance rating shall be determined as follows: The time assigned to the finish as established by Table 4B.21.2.1.4(2) shall be added to the fire-resistance rating determined in Section 4B.21.3.2 for the masonry alone, or in Section 4B.21.3.2.1 for the masonry and finish on the nonfire-exposed side.

**4B.21.3.2.3 Nonsymmetrical assemblies.** For a wall having no finish on one side or having different types or thicknesses of finish on each side, the calculation procedures of this section shall be performed twice, assuming either side of the wall to be the fire-exposed side. The fire-resistance rating of the wall shall not exceed the lower of the two values calculated.

**Exception:** For exterior walls with more than 1.5 m of horizontal separation, the fire shall be assumed to occur on the interior side only.

**4B.21.3.2.4 Minimum concrete masonry fire-resistance rating.** Where the finish applied to a concrete masonry wall contributes to its fire-resistance rating, the masonry alone shall provide not less than one-half the total required fire-resistance rating.

**4B.21.3.2.5 Attachment of finishes.** Installation of finishes shall be as follows:

1. Gypsum wallboard and gypsum lath applied to concrete masonry or concrete walls shall be secured to wood or steel furring members spaced not more than 405 mm on center (o.c.).
2. Gypsum wallboard shall be installed with the long dimension parallel to the furring members and shall have all joints finished.
3. Other aspects of the installation of finishes shall comply with the applicable provisions of this Chapter and Chapter 10 of the SBC 201.

**TABLE 4B.21.3.2**  
**MINIMUM EQUIVALENT THICKNESS (mm) OF BEARING OR NONBEARING**  
**CONCRETE MASONRY WALLS<sup>a,b,c,d</sup>**

TYPE OF AGGREGATE	FIRE-RESISTANCE RATING (hours)														
	½	¾	1	1 ¼	1 ½	1 ¾	2	2 ¼	2 ½	2 ¾	3	3 ¼	3 ½	3 ¾	4
Pumice or expanded slag	40	50	55	65	70	75	80	85	90	95	100	105	110	115	120
Expanded shale, clay or slate	45	55	65	75	85	85	90	95	100	105	110	115	120	125	130
Limestone, cinders or unexpanded slag	50	60	70	80	85	95	100	110	115	120	125	130	140	145	150
Calcareous or siliceous gravel	50	60	70	80	90	100	105	115	120	125	135	140	145	150	160

- a. Values between those shown in the table can be determined by direct interpolation.
- b. Where combustible members are framed into the wall, the thickness of solid material between the end of each member and the opposite face of the wall, or between members set in from opposite sides, shall not be less than 93 percent of the thickness shown in the table.
- c. Requirements of ASTM C 55, ASTM C 73 or ASTM C 90 shall apply.
- d. Minimum required equivalent thickness corresponding to the hourly fire-resistance rating for units with a combination of aggregate shall be determined by linear interpolation based on the percent by volume of each aggregate used in manufacture.

**4B.21.3.3 Multiwythe masonry walls.** The fire-resistance rating of wall assemblies constructed of multiple wythes of masonry materials shall be permitted to be based on the fire-resistance rating period of each wythe and the continuous airspace between each wythe in accordance with the following formula:

$$R_A = \left( R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59} + A_1 + A_2 + \dots + A_n \right)^{1.7} \quad \text{(Equation 4B.-7)}$$

Where:

$R_A$  = Fire endurance rating of the assembly (hours).

$R_1, R_2, \dots, R_n$  = Fire endurance rating of wythes for 1, 2,  $n$  (hours), respectively.

$A_1, A_2, \dots, A_n$  = 0.30, factor for each continuous airspace for 1, 2,  $\dots, n$ , respectively, having a depth of 13 mm or more between wythes.

**4B.21.3.4 Concrete masonry lintels.** Fire-resistance ratings for concrete masonry lintels shall be determined based upon the nominal width of the lintel and the minimum thickness of concrete masonry or concrete, or any combination thereof, covering the main reinforcing bars, as determined according to Table 4B.21.3.4, or by approved alternate methods.

**TABLE 4B.21.3.4**  
**MINIMUM COVER OF LONGITUDINAL REINFORCEMENT**  
**IN FIRE-RESISTANCE-RATED REINFORCED**  
**CONCRETE MASONRY LINTELS (mm)**

NOMINAL WIDTH OF LINTEL (mm)	FIRE-RESISTANCE RATING (hours)			
	1	2	3	4
150	40	50	—	—
200	40	40	45	75
250 or greater	40	40	40	45

**4B.21.3.5 Concrete masonry columns.** The fire-resistance rating of concrete masonry columns shall be determined based upon the least plan dimension of the column in accordance with Table 4B.21.3.5 or by approved alternate methods.

**TABLE 4B.21.3.5**  
**MINIMUM DIMENSION OF CONCRETE**  
**MASONRY COLUMNS (mm)**

FIRE-RESISTANCE RATING (hours)			
1	2	3	4
200	250	305	355

**4B.21.4 Clay brick and tile masonry.** The provisions of this section contain procedures by which the fire-resistance ratings of clay brick and tile masonry are established by calculations.

**4B.21.4.1 Masonry walls.** The fire-resistance rating of masonry walls shall be based upon the equivalent thickness as calculated in accordance with this section. The calculation shall take into account finishes applied to the wall and airspaces between wythes in multi wythe construction.

**4B.21.4.1.1 Equivalent thickness.** The fire-resistance ratings of walls or partitions constructed of solid or hollow clay masonry units shall be determined from Table 4B.21.4.1(1) or 4B.21.4.1(2). The equivalent thickness of the clay masonry unit shall be determined by Equation 4B.-8 when using Table 4B.21.4.1(1). The fire-resistance rating determined from Table 4B.21.4.1(1) shall be permitted to be used in the calculated fire-resistance rating procedure in Section 4B.21.4.2.

$$T_e = V_n / LH \quad \text{(Equation 4B.-8)}$$

Where:

$T_e$  = The equivalent thickness of the clay masonry unit (mm).

$V_n$  = The net volume of the clay masonry unit (mm<sup>3</sup>).

$L$  = The specified length of the clay masonry unit (mm).

$H$  = The specified height of the clay masonry unit (mm).

**4B.21.4.1.1.1 Hollow clay units.** The equivalent thickness,  $T_e$ , shall be the value obtained for hollow clay units as determined in accordance with ASTM C67.

**TABLE 4B.21.4.1(1)**  
**FIRE-RESISTANCE PERIODS OF CLAY MASONRY WALLS**

MATERIAL TYPE	MINIMUM REQUIRED EQUIVALENT THICKNESS FOR FIRE RESISTANCE <sup>a,b,c</sup> (mm)			
	1 hour	2 hour	3 hour	4 hour
Solid brick of clay or shale <sup>d</sup>	70	95	125	150
Hollow brick or tile of clay or shale, unfilled	60	85	110	125
Hollow brick or tile of clay or shale, grouted or filled with materials specified in Section 4B.21.4.1.1.3	75	110	140	170

- Equivalent thickness as determined from Section 4B.21.4.1.1.
- Calculated fire resistance between the hourly increments listed shall be determined by linear interpolation.
- Where combustible members are framed in the wall, the thickness of solid material between the end of each member and the opposite face of the wall, or between members set in from opposite sides, shall not be less than 93 percent of the thickness shown.
- For units in which the net cross-sectional area of cored brick in any plane parallel to the surface containing the cores is at least 75 percent of the gross cross-sectional area measured in the same plane.

**TABLE 4B.21.4.1(2)**  
**FIRE-RESISTANCE RATINGS FOR BEARING STEEL FRAME  
BRICK VENEER WALLS OR PARTITIONS**

WALL OR PARTITION ASSEMBLY	PLASTER SIDE EXPOSED (hours)	BRICK FACED SIDE EXPOSED (hours)
Outside facing of steel studs: 13 mm wood fiberboard sheathing next to studs, 20 mm airspace formed with 20 mm × 40 mm wood strips placed over the fiberboard and secured to the studs; metal or wire lath nailed to such strips, 95 mm brick veneer held in place by filling 20 mm airspace between the brick and lath with mortar. Inside facing of studs: 20 mm unsanded gypsum plaster on metal or wire lath attached to 8 mm wood strips secured to edges of the studs	1.5	4
Outside facing of steel studs: 25 mm insulation board sheathing attached to studs, 25 mm airspace, and 95 mm brick veneer attached to steel frame with metal ties every 5th course. Inside facing of studs: 22 mm sanded gypsum plaster (1:2 mix) applied on metal or wire lath attached directly to the studs	1.5	4
Same as above except use 22 mm vermiculite—gypsum plaster or 25 mm sanded gypsum plaster (1:2 mix) applied to metal or wire	2	4
Outside facing of steel studs: 13 mm gypsum sheathing board, attached to studs, and 95 mm brick veneer attached to steel frame with metal ties every 5th course. Inside facing of studs: 13 mm sanded gypsum plaster (1:2 mix) applied to 13 mm perforated gypsum lath securely attached to studs and having strips of metal lath 75 mm wide applied to all horizontal joints of gypsum lath	2	4



**4B.21.4.1.1.2 Solid grouted clay units.** The equivalent thickness of solid grouted clay masonry units shall be taken as the actual thickness of the units.

**4B.21.4.1.1.3 Units with filled cores.** The equivalent thickness of the hollow clay masonry units is the actual thickness of the unit when completely filled with loose-fill materials of: sand, pea gravel, crushed stone, or slag that meet ASTM C 33 requirements; pumice, scoria, expanded shale, expanded clay, expanded slate, expanded slag, expanded fly ash, or cinders in compliance with ASTM C 331; or perlite or vermiculite meeting the requirements of ASTM C 549 and ASTM C 516), respectively.

**4B.21.4.1.2 Plaster finishes.** Where plaster is applied to the wall, the total fire-resistance rating shall be determined by the formula:

$$R = (R_n^{0.59} + pl)^{1.7} \quad \text{(Equation 4B-9)}$$

Where:

$R$  = The fire endurance of the assembly (hours).

$R_n$  = The fire endurance of the individual wall (hours).

$pl$  = Coefficient for thickness of plaster.

Values for  $R_n^{0.59}$  for use in Equation 4B-9 are given in Table 4B.21.4.1(3). Coefficients for thickness of plaster shall be selected from Table 4B.21.4.1(4) based on the actual thickness of plaster applied to the wall or partition and whether one or two sides of the wall are plastered.

**4B.21.4.1.3 Multiwythe walls with airspace.** Where a continuous airspace separates multiple wythes of the wall or partition, the total fire-resistance rating shall be determined by the formula:

$$R = (R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59} + as)^{1.7} \quad \text{(Equation 4B-10)}$$

Where:

$R$  = The fire endurance of the assembly (hours).

$R_1, R_2$  and  $R_n$  = The fire endurance of the individual wall (hours).

$as$  = Coefficient for continuous airspace.

Values for  $R_n^{0.59}$  for use in Equation 4B-10 are given in Table 4B.21.4.1(3). The coefficient for each continuous airspace of 13 mm to 90 mm separating two individual wythes shall be 0.3.

**4B.21.4.1.4 Nonsymmetrical assemblies.** For a wall having no finish on one side or having different types or thicknesses of finish on each side, the calculation procedures of this section shall be performed twice, assuming either side to be the fire-exposed side of the wall. The fire resistance of the wall shall not exceed the lower of the two values determined.

**Exception:** For exterior walls with more than 1.5 m of horizontal separation, the fire shall be assumed to occur on the interior side only.

**TABLE 4B.21.4.1(3)**  
**VALUES OF  $R_n^{0.59}$**

$R_n^{0.59}$	R (hours)
1	1.0
2	1.50
3	1.91
4	2.27

**TABLE 4B.21.4.1(4)**  
**COEFFICIENTS FOR PLASTER,  $pl^a$**

THICKNESS OF PLASTER (mm)	ONE SIDE	TWO SIDE
13	0.3	0.6
16	0.37	0.75
20	0.45	0.90

a. Values listed in table are for 1:3 sanded gypsum plaster.

**TABLE 4B.21.4.1(5)**  
**REINFORCED MASONRY LINTELS**

NOMINAL LINTEL WIDTH (mm)	MINIMUM LONGITUDINAL REINFORCEMENT COVER FOR FIRE RESISTANCE (mm)			
	1 hour	2 hour	3 hour	4 hour
150	40	50	NP	NP
200	40	40	45	75
250 or more	40	40	40	45

NP = Not permitted.

**TABLE 4B.21.4.1(6)**  
**REINFORCED CLAY MASONRY COLUMNS**

COLUMN SIZE	FIRE-RESISTANCE RATING (hour)			
	1	2	3	4
Minimum column dimension (mm)	200	250	305	355

**4B.21.4.2 Multiwythe walls.** The fire-resistance rating for walls or partitions consisting of two or more dissimilar wythes shall be permitted to be determined by the formula:

$$R = \left( R_1^{0.59} + R_2^{0.59} + \dots + R_n^{0.59} \right)^{1.7} \quad \text{(Equation 4B.-11)}$$

Where:

$R$  = The fire endurance of the assembly (hours).

$R_1, R_2$  and  $R_n$  = The fire endurance of the individual wall (hours).

Values for  $R_n^{0.59}$  for use in Equation 4B.-11 are given in Table 4B.21.4.1(3).

**4B.21.4.2.1 Multiwythe walls of different material.** For walls that consist of two or more wythes of different materials (concrete or concrete masonry units) in combination with clay masonry units, the fire-resistance rating of the different materials shall be permitted to be determined from Table 4B.21.2.1.1 for concrete; Table 4B.21.3.2 for concrete masonry units or Table 4B.21.4.1(1) or 4B.21.4.1(2) for clay brick and tile masonry units.

**4B.21.4.3 Reinforced clay masonry lintels.** Fire-resistance ratings for clay masonry lintels shall be determined based on the nominal width of the lintel and the minimum covering for the longitudinal reinforcement in accordance with Table 4B.21.4.1(5).

**4B.21.4.4 Reinforced clay masonry columns.** The fire-resistance ratings shall be determined based on the least plan dimension of the column in accordance with Table 4B.21.4.1(6). The minimum cover for longitudinal reinforcement shall be 50 mm.

**4B.21.5 Steel assemblies.** The provisions of this section contain procedures by which the fire-resistance ratings of steel assemblies are established by calculations.

- 4B.21.5.1 Structural steel columns.** The fire-resistance ratings of steel columns shall be based on the size of the element and the type of protection provided in accordance with this section.
- 4B.21.5.1.1 General.** These procedures establish a basis for determining the fire resistance of column assemblies as a function of the thickness of fire-resistant material and, the weight,  $W$ , and heated perimeter,  $D$ , of steel columns. As used in these sections,  $W$  is the average weight of a structural steel column in kilograms per linear meter. The heated perimeter,  $D$ , is the inside perimeter of the fire-resistant material in millimeters as illustrated in Figure 4B.21.5.1(1).
- 4B.21.5.1.1.1 Nonload-bearing protection.** The application of these procedures shall be limited to column assemblies in which the fire-resistant material is not designed to carry any of the load acting on the column.
- 4B.21.5.1.1.2 Embedments.** In the absence of substantiating fire-endurance test results, ducts, conduit, piping, and similar mechanical, electrical, and plumbing installations shall not be embedded in any required fire-resistant materials.
- 4B.21.5.1.1.3 Weight-to-perimeter ratio.** Table 4B.21.5.1(1) contains weight-to-heated-perimeter ratios ( $W/D$ ) for both contour and box fire-resistant profiles, for some wide flange shapes. For different fire-resistant protection profiles or column cross sections, the weight-to-heated-perimeter ratios ( $W/D$ ) shall be determined in accordance with the definitions given in this section.

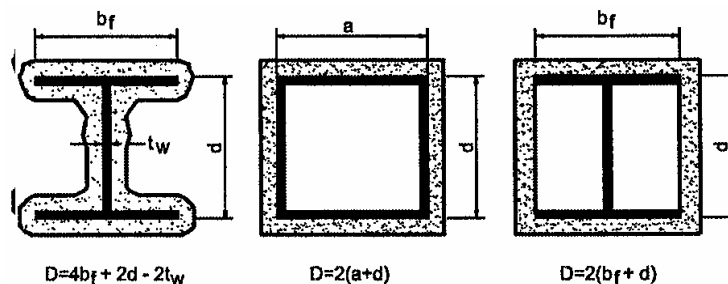


FIGURE 4B.21.5.1(1)  
DETERMINATION OF THE HEATED PERIMETER OF STRUCTURAL  
STEEL COLUMNS

- 4B.21.5.1.2 Gypsum wallboard protection.** The fire resistance of structural steel columns with weight to-heated-perimeter ratios ( $W/D$ ) less than or equal to 0.214 and which are protected with Type X gypsum wallboard shall be permitted to be determined from the following expression:

$$R = 130 \left[ \frac{h(W' / D)}{2.976} \right]^{0.75} \quad \text{(Equation 4B.-12)}$$

Where:

- $R$  = Fire resistance (minutes).  
 $H$  = Total thickness of gypsum wallboard (mm).  
 $D$  = Heated perimeter of the structural steel column (mm).  
 $W'$  = Total weight of the structural steel column and gypsum wallboard protection (kilogram per linear meter).  
 $W' = W + 800hD/10^6$ .

Alternatively, the determination of the fire resistance of structural steel columns from Figure 4B.21.5.1(4) is permitted for various thicknesses of gypsum wallboard as a function of the weight-to-heated-perimeter ratio ( $W/D$ ) of the column.

For structural steel columns with weight-to-heated-perimeter ratios (W/D) greater than 0.21, the thickness of gypsum wallboard required for specified fire-resistance ratings shall be the same as the thickness determined for a wide flange shape with W/D equals to 0.21.

**4B.21.5.1.2.1 Attachment.** The gypsum wallboard shall be supported as illustrated in either Figure 4B.21.5.1(2) for fire-resistance ratings of 4 hours or less, or Figure 4B.21.5.1(3) for fire-resistance ratings of 3 hours or less.

**4B.21.5.1.2.2 Gypsum wallboard equivalent to concrete.** The determination of the fire resistance of structural steel columns from Figure 4B.21.5.1(4) is permitted for various thicknesses of gypsum wallboard as a function of the weight-to-heated-perimeter ratio (W/D) of the column. For structural steel columns with weight-to-heated-perimeter ratios (W/D) greater than 0.21, the thickness of gypsum wallboard required for specified fire-resistance ratings shall be the same as the thickness determined for a wide flange shape with W/D equals to 0.21.

**4B.21.5.1.3 Spray-applied fire-resistant materials.** The fire resistance of wide-flange structural steel columns protected with spray-applied fire-resistant materials, as illustrated in Figure 4B.21.5.1(5), shall be permitted to be determined from the following expression:

$$R = [ C_1 (W / D) + C_2 ] h \quad \text{(Equation 4B.-13)}$$

Where:

$R$  = Fire resistance (minutes)

$h$  = Thickness of spray-applied fire-resistant material (mm)

$D$  = Heated perimeter of the structural steel column (mm)

$C_1$  and  $C_2$  = Material-dependent constants

$W$  = Weight of structural steel column (kilograms per linear meter)

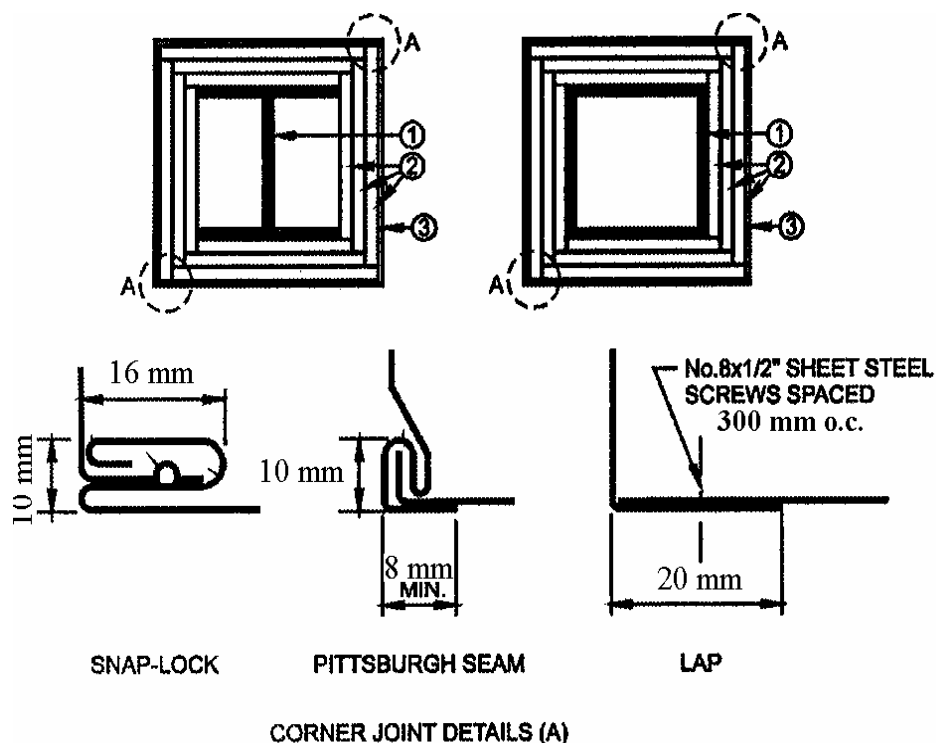


FIGURE 4B.21.5.1(2)  
GYPSUM WALLBOARD PROTECTED STRUCTURAL STEEL COLUMNS WITH  
SHEET STEEL COLUMN COVERS

1. Structural steel column, either wide flange or tubular shapes.
2. Type X gypsum wall board in accordance with ASTM C 36). For single-layer applications, the wallboard shall be applied vertically with no horizontal joints. For multiple-layer applications, horizontal joints are permitted at a minimum spacing of 2.4 m, provided that the joints in successive layers are staggered at least 305 mm. The total required thickness of wallboard shall be determined on the basis of the specified fire-resistance rating and the weight-to-heated-perimeter ratio ( $W/D$ ) of the column. For fire-resistance ratings of 2 hours or less, one of the required layers of gypsum wallboard may be applied to the exterior of the sheet steel column covers with 25 mm long Type S screws spaced 25 mm from the wallboard edge and 200 mm on center. For such installations, 0.38-mm minimum thickness galvanized steel corner beads with 40 mm legs shall be attached to the wallboard with Type S screws spaced 305 mm on center.
3. For fire-resistance ratings of 3 hours or less, the column covers shall be fabricated from 0.6-mm minimum thickness galvanized or stainless steel. For 4-hour fire-resistance ratings, the column covers shall be fabricated from 0.6-mm minimum thickness stainless steel. The column covers shall be erected with the Snap Lock or Pittsburgh joint details. For fire-resistance ratings of 2 hours or less, column covers fabricated from 0.68-mm minimum thickness galvanized or stainless steel shall be permitted to be erected with lap joints. The lap joints shall be permitted to be located anywhere around the perimeter of the column cover. The lap joints shall be secured with 13 mm-long No. 8 sheet metal screws spaced 305 mm on center. The column covers shall be provided with a minimum expansion clearance of 10 mm per linear meter between the ends of the cover and any restraining construction.

**4B.21.5.1.3.1 Material-dependent constants.** The material-dependent constants,  $C_1$  and  $C_2$ , shall be determined for specific fire-resistant materials on the basis of standard fire endurance tests in accordance with Section 4B.3.2. Unless evidence is submitted to the building official substantiating a broader application, this expression shall be limited to determining the fire resistance of structural steel columns with weight-to-heated-perimeter ratios ( $W/D$ ) between the largest and smallest columns for which standard fire-endurance test results are available.

**4B.21.5.1.3.2 Spray-applied identification.** Spray-applied fire-resistant materials shall be identified by density and thickness required for a given fire-resistance rating.

**4B.21.5.1.4 Concrete-protected columns.** The fire resistance of structural steel columns protected with concrete, as illustrated in Figure 4B.21.5.1(6) (a) and (b), shall be permitted to be determined from the following expression:

$$R = R_o (1 + 0.03m) \quad \text{(Equation 4B.-14)}$$

where:

$$R_o = 73 (W/D)^{0.7} + 0.107 \times (h^{1.6}/k_c^{0.2}) \times (1 + 30784 (H/p_c c_c h (L + h))^{0.8})$$

As used in these expressions:

$R$  = Fire endurance at equilibrium moisture conditions (minutes)

$R_o$  = Fire endurance at zero moisture content (minutes)

$M$  = Equilibrium moisture content of the concrete by volume (percent)

$W$  = Average weight of the steel column (kilograms per linear meter)

$D$  = Heated perimeter of the steel column (mm)

$H$  = Thickness of the concrete cover (mm)

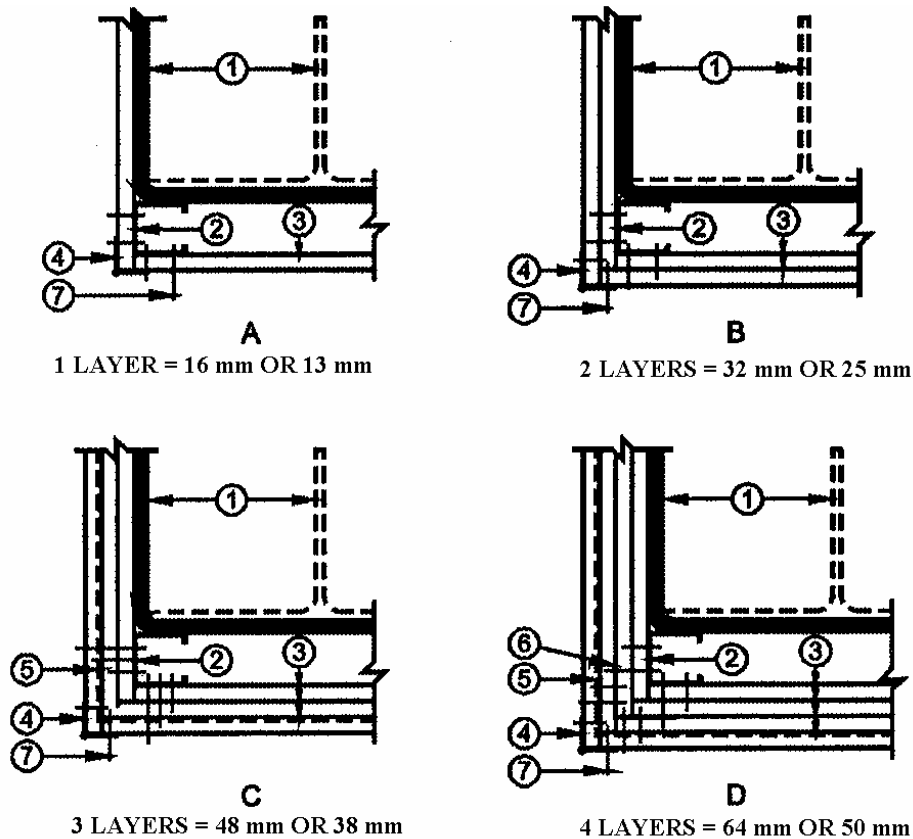
$k_c$  = Ambient temperature thermal conductivity of the concrete (Watt/m.°K)

$H$  = Ambient temperature thermal capacity of the steel column =  $0.46W$  (kJ/m.°K)

$p_c$  = Concrete density (kg/m<sup>3</sup>)

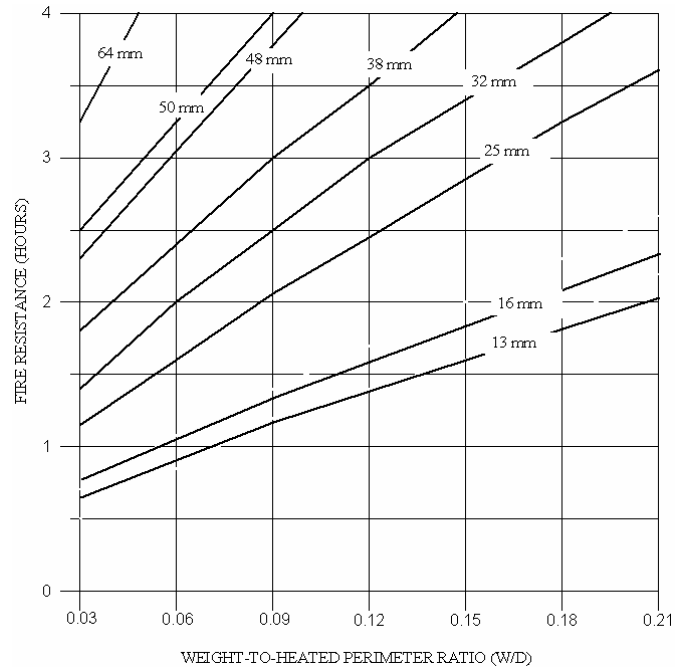
$c_c$  = Ambient temperature specific heat of concrete (kJ/kg.°K)

$L$  = Interior dimension of one side of a square concrete box protection (mm)



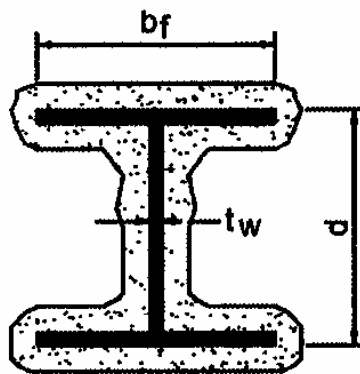
**FIGURE 4B.21.5.1(3)**  
**GYPSON WALLBOARD PROTECTED STRUCTURAL STEEL COLUMNS WITH STEEL**  
**STUD/SCREW ATTACHMENT SYSTEM**

1. Structural steel column, either wide flange or tubular shapes.
2. 40 mm deep studs fabricated from 0.45-mm minimum thickness galvanized steel with 35 mm or 37 mm legs. The length of the steel studs shall be 13 mm less than the height of the assembly.
3. Type X gypsum wall board in accordance with ASTM C 36). For single-layer applications, the wallboard shall be applied vertically with no horizontal joints. For multiple-layer applications, horizontal joints are permitted at a minimum spacing of 2.4 m, provided that the joints in successive layers are staggered at least 305 mm. The total required thickness of wallboard shall be determined on the basis of the specified fire-resistance rating and the weight-to-heated-perimeter ratio ( $W/D$ ) of the column.
4. Galvanized 0.38-mm minimum thickness steel corner beads with 40 mm legs attached to the wallboard with 25 mm-long Type S screws spaced 305 mm on center.
5. 1.3 mm (No. 18 SWG) steel tie wires spaced 610 mm on center.
6. Sheet metal angles with 50 mm legs fabricated from 0.56-mm minimum thickness galvanized steel.
7. Type S screws, 25 mm long, shall be used for attaching the first layer of wallboard to the steel studs and the third layer to the sheet metal angles at 610 mm on center. Type S screws 45 mm long shall be used for attaching the second layer of wallboard to the steel studs and the fourth layer to the sheet metal angles at 305 mm on center. Type S screws 60 mm long shall be used for attaching the third layer of wallboard to the steel studs at 305 mm on center.



**FIGURE 4B.21.5.1(4)**  
**FIRE RESISTANCE OF STRUCTURAL STEEL COLUMNS PROTECTED WITH VARIOUS THICKNESSES OF TYPE X GYPSUM WALLBOARD**

- a. The W/D ratios for typical wide flange columns are listed in Table 4B.21.5.1(1). For other column shapes, the W/D ratios shall be determined in accordance with Section 4B.21.5.1.1.



**FIGURE 4B.21.5.1(5)**  
**WIDE FLANGE STRUCTURAL STEEL COLUMNS WITH SPRAY-APPLIED FIRE-RESISTANT MATERIALS**

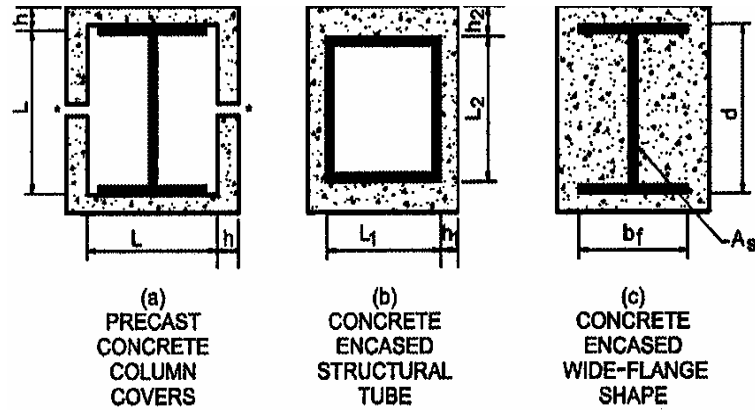


FIGURE 4B.21.5.1(6)  
CONCRETE PROTECTED STRUCTURAL STEEL COLUMNS<sup>a,b</sup>

- a. When the inside perimeter of the concrete protection is not square,  $L$  shall be taken as the average of  $L_1$  and  $L_2$ . When the thickness of concrete cover is not constant,  $h$  shall be taken as the average of  $h_1$  and  $h_2$ .
- b. Joints shall be protected with a minimum 25 mm thickness of ceramic fiber blanket but in no case less than one-half the thickness of the column cover (see Section 4B.21.2.1.3).

**4B.21.5.1.4.1 Reentrant space filled.** For wide-flange steel columns completely encased in concrete with all reentrant spaces filled [Figure 4B.21.5.1(6)(c)], the thermal capacity of the concrete within the reentrant spaces shall be permitted to be added to the thermal capacity of the steel column, as follows:

$$H = 0.46W + 1 \times 10^{-6} p_c c_c (b_f d - A_s) \quad (\text{Equation 4B.-15})$$

Where:

$b_f$  = Flange width of the steel column (mm)

$d$  = Depth of the steel column (mm)

$A_s$  = Cross-sectional area of the steel column (square mm)

**4B.21.5.1.4.2 Concrete properties unknown.** If specific data on the properties of concrete are not available, the values given in Table 4B.21.5.1(2) are permitted.

**4B.21.5.1.4.3 Minimum concrete cover.** For structural steel column encased in concrete with all reentrant spaces filled, Figure 4B.21.5.1(6)(c) and Tables 4B.21.5.1(7) and 4B.21.5.1(8) indicate the thickness of concrete cover required for various fire-resistance ratings for typical wide-flange sections. The thicknesses of concrete indicated in these tables also apply to structural steel columns larger than those listed.

**4B.21.5.1.4.4 Minimum precast concrete cover.** For structural steel columns protected with precast concrete column covers as shown in Figure 4B.21.5.1(6)(a), Tables 4B.21.5.1(9) and 4B.21.5.1(10) indicate the thickness of the column covers required for various fire-resistance ratings for typical wide-flange shapes. The thicknesses of concrete given in these tables also apply to structural steel columns larger than those listed.

**4B.21.5.1.4.5 Masonry protection.** The fire resistance of structural steel columns protected with concrete masonry units or clay masonry units as illustrated in Figure 4B.21.5.1(7), shall be permitted to be determined from the following expression:

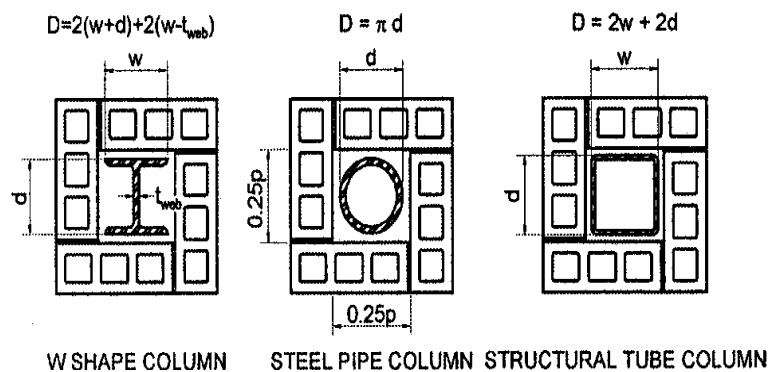
$$R = 1.24 (W/D)^{0.7} + [0.0018 (T_e^{1.6}/k_m^{0.2})] \times [1.0 + 392.76 \{ (A_s/d_m T_e) / (0.25p + T_e) \}^{0.8}] \quad (\text{Equation 4B.-16})$$



Where:

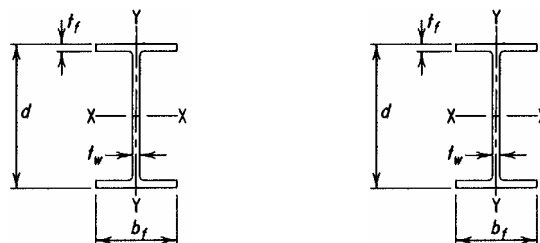
- $R$  = Fire-resistance rating of column assembly (hours).  
 $W$  = Average weight of steel column ( $\text{kg/m}^3$ ).  
 $D$  = Heated perimeter of steel column (mm) [see Figure 4B.21.5.1(7)].  
 $T_e$  = Equivalent thickness of concrete or clay masonry unit (mm) (see Table 4B.21.3.2 Note a or Section 4B.21.4.1).  
 $k_m$  = Thermal conductivity of concrete or clay masonry unit ( $\text{Watt/m}^\circ\text{K}$ ) [see Table 4B.21.5.1(3)].  
 $A_s$  = Cross-sectional area of steel column (square mm).  
 $d_m$  = Density of the concrete or clay masonry unit ( $\text{kg/m}^3$ ).  
 $P$  = Inner perimeter of concrete or clay masonry protection (mm) [see Figure 4B.21.5.1(7)].

**4B.21.5.1.4.6 Equivalent masonry thickness.** For structural steel columns protected with concrete masonry, Table 4B.21.5.1(5) gives the equivalent thickness of concrete masonry required for various fire-resistance ratings for typical column shapes. For structural steel columns protected with clay masonry, Table 4B.21.5.1(6) gives the equivalent thickness of clay masonry required for various fire-resistance ratings for typical column shapes.



**FIGURE 4B.21.5.1(7)**  
**CONCRETE OR CLAY MASONRY PROTECTED STRUCTURAL STEEL COLUMNS**

- $d$  = Depth of a wide flange column, outside diameter of pipe column, or outside dimension of structural tubing column (mm).  
 $t_{web}$  = Thickness of web of wide flange column (mm).  
 $w$  = Width of flange of wide flange column or outside dimension of structural tubing column (mm).



**TABLE 4B.21.5.1(1)**  
**W/D RATIOS FOR STEEL COLUMNS**

Shape Designation		Weight	Area	d	t <sub>w</sub>	b <sub>f</sub>	t <sub>f</sub>	Contour	Box
in. × lb/ft	mm × kg/m	kg/m	A <sub>s</sub> mm <sup>2</sup>	mm	mm	mm	mm	Profile kg/m/mm	Profile kg/m/mm
W14×233	W360×347	347	44200	407	27.2	404	43.7	0.146	0.214
W14×211	W360×314	314	39900	399	24.9	401	39.6	0.133	0.196
W14×193	W360×287	287	36600	393	22.6	399	36.6	0.123	0.181
W14×176	W360×262	262	33500	387	21.1	398	33.3	0.113	0.167
W14×159	W360×237	237	30100	380	18.9	395	30.2	0.103	0.153
W14×145	W360×216	216	27600	375	17.3	394	27.7	0.094	0.140
W14×82	W360×122	122	15500	363	13	257	21.7	0.071	0.098
W14×68	W360×101	101	12900	357	10.5	255	18.3	0.059	0.083
W14×53	W360×79	79	10100	354	9.4	205	16.8	0.052	0.071
W14×43	W360×64	64	8140	347	7.7	203	13.5	0.043	0.058
W12×190	W310×283	283	36000	365	26.9	322	44.1	0.144	0.206
W12×170	W310×253	253	32200	356	24.4	319	39.6	0.130	0.187
W12×152	W310×226	226	28900	348	22.1	317	35.6	0.118	0.170
W12×136	W310×202	202	25800	341	20.1	315	31.8	0.106	0.154
W12×72	W310×107	107	13600	311	10.9	306	17	0.059	0.087
W12×58	W310×86	86	11000	310	9.1	254	16.3	0.053	0.076
W12×50	W310×74	74	9490	310	9.4	205	16.3	0.052	0.072
W12×40	W310×60	60	7590	303	7.5	203	13.1	0.043	0.059
W10×112	W250×167	167	21300	289	19.2	265	31.8	0.104	0.151
W10×100	W250×149	149	19000	282	17.3	263	28.4	0.094	0.137
W10×88	W250×131	131	16700	275	15.4	261	25.1	0.084	0.122
W10×77	W250×115	115	14600	269	13.5	259	22.1	0.074	0.109
W10×68	W250×101	101	12900	264	11.9	257	19.6	0.066	0.097
W10×54	W250×80	80	10200	256	9.4	255	15.6	0.053	0.078
W10×45	W250×67	67	8550	275	8.9	204	15.7	0.050	0.070
W10×33	W250×49.1	49.1	6250	247	7.4	202	11	0.038	0.055
W8×40	W200×59	59	7560	210	9.1	205	14.2	0.048	0.071
W8×35	W200×52	52	6660	206	7.9	204	12.6	0.043	0.063
W8×31	W200×46.1	46.1	5860	203	7.2	203	11.8	0.038	0.057
W8×28	W200×41.7	41.7	5310	205	7.2	166	11.8	0.039	0.056
W8×24	W200×35.9	35.9	4580	201	6.2	165	10.2	0.034	0.049
W8×18	W200×26.6	26.6	3390	207	5.8	133	8.4	0.028	0.039

**TABLE 4B.21.5.1(2)**  
**PROPERTIES OF CONCRETE**

PROPERTY	NORMAL WEIGHT CONCRETE	STRUCTURAL LIGHTWEIGHT CONCRETE
Thermal conductivity ( $k_c$ )	1.64 Watt/m · °K	0.61 Watt/m · °K
Specific heat ( $c_c$ )	0.84 kJ/kg · °K	0.84 kJ/kg · °K
Density ( $P_c$ )	2400 kg/m <sup>3</sup>	1750 kg/m <sup>3</sup>
Equilibrium (free) moisture content (m) by volume	4%	5%

**TABLE 4B.21.5.1(3)**  
**THERMAL CONDUCTIVITY OF CONCRETE OR CLAY MASONRY UNITS**

DENSITY ( $d_m$ ) OF UNITS ( $\text{kg/m}^3$ )	THERMAL CONDUCTIVITY ( $k_m$ ) OF UNITS ( $\text{Watt/m} \cdot ^\circ\text{K}$ )
<b>Concrete Masonry Units</b>	
1280	0.358
1360	0.395
1440	0.436
1520	0.481
1600	0.533
1680	0.588
1760	0.651
1840	0.720
1920	0.794
2000	0.879
2080	0.971
2160	1.073
2240	1.186
2320	1.312
2400	1.449
<b>Clay Masonry Units</b>	
1920	2.16
2080	3.89

**TABLE 4B.21.5.1(4)**  
**WEIGHT-TO-HEATED-PERIMETER RATIOS (W/D) FOR TYPICAL WIDE FLANGE  
BEAM AND GIRDER SHAPES**

Shape Designation		weight kg/m	Area $A_s$ $\text{mm}^2$	Depth d mm	$t_w$ mm	Width $b_f$ mm	$t_f$ mm	Contour Profile kg/m/mm	Box Profile kg/m/mm
in.xlb/ft	mm×kg/m								
W36×300	W920×446	446	57000	933	24	423	42.7	0.144	0.195
W36×280	W920×417	417	53300	928	22.5	422	39.9	0.136	0.183
W36×260	W920×387	387	49300	921	21.3	420	36.6	0.126	0.171
W36×245	W920×365	365	46400	916	20.3	419	34.3	0.120	0.162
W36×230	W920×342	342	43600	912	19.3	418	32	0.113	0.153
W33×241	W840×359	359	45800	868	21.1	403	35.6	0.124	0.168
W33×221	W840×329	329	42000	862	19.7	401	32.4	0.114	0.155
W33×201	W840×299	299	38100	855	18.2	400	29.2	0.104	0.142
W33×152	W840×226	226	28900	851	16.1	294	26.8	0.089	0.113
W30×211	W760×314	314	40100	786	19.7	384	33.4	0.117	0.161
W30×191	W760×284	284	36200	779	18	382	30.1	0.106	0.146
W30×173	W760×257	257	32600	773	16.6	381	27.1	0.097	0.133
W30×132	W760×196	196	25100	770	15.6	268	25.4	0.085	0.108

**TABLE 4B.21.5.1(5)**  
**FIRE RESISTANCE OF CONCRETE MASONRY PROTECTED STEEL COLUMNS**

Shape Designation		W/D kg/m/mm	Concrete Masonry Density (kg/m <sup>3</sup> )	Minimum Required Equivalent Thickness For Fire-resistance Rating of Concrete Masonry Protection Assembly $T_e$ (mm)			
in. x lb/ft	mm x kg/m			1-hour	2-hour	3-hour	4-hour
W14×82	W360×122	0.09839	1280	18	39	58	75
			1600	22	46	66	84
			1760	24	49	70	89
			1920	26	52	74	93
W14×68	W360×101	0.08252	1280	21	42	61	79
			1600	25	49	69	88
			1760	27	52	73	92
			1920	28	55	77	97
W14×53	W360×79	0.07066	1280	23	45	65	82
			1600	27	52	72	91
			1760	29	54	76	95
			1920	31	57	80	99
W14×43	W360×64	0.05818	1280	25	48	68	86
			1600	29	55	76	94
			1760	31	57	79	98
			1920	33	60	83	102
W12×72	W310×107	0.08671	1280	20	42	61	78
			1600	24	48	69	87
			1760	26	51	72	92
			1920	28	54	76	96
W12×58	W310×86	0.07624	1280	22	44	63	81
			1600	26	50	71	90
			1760	28	53	75	94
			1920	30	56	78	98
W12×50	W310×74	0.07184	1280	23	45	65	82
			1600	27	51	72	91
			1760	29	54	76	95
			1920	31	57	80	100
W12×40	W310×60	0.05929	1280	25	49	68	86
			1600	29	55	76	95
			1760	31	57	79	99
			1920	33	60	83	103
W10×68	W250×101	0.09693	1280	19	40	59	76
			1600	23	47	67	86
			1760	25	50	71	90
			1920	27	53	75	94
W10×54	W250×80	0.07828	1280	22	44	63	81
			1600	26	50	71	90
			1760	28	53	75	94
			1920	30	56	79	98
W10×45	W250×67	0.06994	1280	23	46	66	83
			1600	27	52	73	92
			1760	29	55	77	96
			1920	31	58	80	100

**TABLE 4B.21.5.1(5) – Continued**  
**FIRE RESISTANCE OF CONCRETE MASONRY PROTECTED STEEL COLUMNS**

Shape Designation		W/D kg/m/mm	Concrete Masonry Density (kg/m <sup>3</sup> )	Minimum Required Equivalent Thickness For Fire-resistance Rating of Concrete Masonry Protection Assembly $T_e$ (mm)			
in. x lb/ft	mm x kg/m			1-hour	2-hour	3-hour	4-hour
W10×33	W250×49.1	0.05468	1280	27	50	70	88
			1600	31	56	77	96
			1760	32	59	81	100
			1920	34	62	84	104
W8×40	W200×59	0.07108	1280	23	46	66	84
			1600	27	53	74	93
			1760	29	55	77	97
			1920	31	58	81	101
W8×31	W200×46.1	0.05677	1280	26	50	70	88
			1600	30	56	77	96
			1760	32	59	81	100
			1920	34	61	84	104
W8×24	W200×35.9	0.04904	1280	28	52	72	90
			1600	32	58	80	99
			1760	34	61	83	102
			1920	36	63	86	106
W8×18	W200×26.6	0.03912	1280	31	55	76	94
			1600	35	61	82	101
			1760	36	63	85	105
			1920	38	66	89	109

Note: Tabulated values assume 25-mm air gap between masonry and steel section.

**TABLE 4B.21.5.1(6)**  
**FIRE RESISTANCE OF CLAY MASONRY PROTECTED STEEL COLUMNS**

Shape Designation		W/D kg/m/mm	Concrete Masonry Density (kg/m <sup>3</sup> )	Minimum Required Equivalent Thickness For Fire-Resistance Rating of Concrete Masonry Protection Assembly, $T_e$ (mm)			
				1-hour	2-hour	3-hour	4-hour
W14×82	W360×122	0.09839	1920	31	61	86	108
			2080	35	68	96	120
W14×68	W360×101	0.08252	1920	34	64	89	112
			2080	38	71	99	123
W14×53	W360×79	0.07066	1920	36	67	92	115
			2080	41	74	102	126
W14×43	W360×64	0.05818	1920	39	70	95	118
			2080	43	77	105	129
W12×72	W310×107	0.08671	1920	33	63	89	111
			2080	38	71	98	122
W12×58	W310×86	0.07624	1920	35	66	91	114
			2080	40	73	101	125
W12×50	W310×74	0.07184	1920	36	67	92	115
			2080	40	74	102	126
W12×40	W310×60	0.05929	1920	39	70	96	118
			2080	43	77	105	129
W10×68	W250×101	0.09693	1920	32	62	87	110
			2080	36	69	97	121
W10×54	W250×80	0.07828	1920	35	66	91	114
			2080	40	73	101	125
W10×45	W250×67	0.06994	1920	37	68	93	116
			2080	41	75	103	127
W10×33	W250×49.1	0.05468	1920	40	71	97	120
			2080	45	79	106	131
W8×40	W200×59	0.07108	1920	37	68	94	116
			2080	41	75	103	128
W8×31	W200×46.1	0.05677	1920	40	71	97	120
			2080	45	78	106	131
W8×24	W200×35.9	0.04904	1920	42	73	99	122
			2080	46	80	108	133
W8×18	W200×26.6	0.03912	1920	44	76	102	124
			2080	49	83	111	135

Note: Tabulated values assume 25-mm air gap between masonry and steel section.

**TABLE 4B.21.5.1(7)**  
**MINIMUM COVER (mm) FOR STEEL COLUMNS ENCASED IN**  
**NORMAL-WEIGHT CONCRETE<sup>a</sup> [FIGURE 4B.21.5.1(6)(c)]**

Shape Designation		W/D	Fire-Resistance Rating (hours)				
in. x lb/ft	mm x kg/m	kg/m/mm	1	1.5	2	3	4
W14×233	W360×347	0.146	25	25	25	40	55
W14×211	W360×314	0.133	25	25	25	40	55
W14×193	W360×287	0.123	25	25	25	40	55
W14×176	W360×262	0.113	25	25	25	40	55
W14×159	W360×237	0.103	25	25	25	40	60
W14×145	W360×216	0.094	25	25	25	45	60
W12×190	W310×283	0.144	25	25	25	45	60
W12×170	W310×253	0.130	25	25	25	45	60
W12×152	W310×226	0.118	25	25	30	45	60
W12×136	W310×202	0.106	25	25	30	45	65
W10×112	W250×167	0.104	25	25	30	50	70
W10×100	W250×149	0.094	25	25	35	50	70
W10×88	W250×131	0.084	25	25	35	55	70
W10×77	W250×115	0.074	25	25	35	55	70
W8×35	W200×52	0.043	25	30	45	65	85
W8×28	W200×41.7	0.039	25	35	45	70	90
W8×24	W200×35.9	0.034	25	35	45	70	90
W8×18	W200×26.6	0.028	25	40	50	70	95

- a. The tabulated thicknesses are based upon the assumed properties of normal-weight concrete given in Table 4B.21.5.1(2).

**TABLE 4B.21.5.1(8)**  
**MINIMUM COVER (mm) FOR STEEL COLUMNS ENCASED IN STRUCTURAL**  
**LIGHTWEIGHT CONCRETE<sup>a</sup> [FIGURE 4B.21.5.1(6)(c)]**

Shape Designation		W/D	Fire-Resistance Rating (hours)				
in. x lb/ft	mm x kg/m	kg/m/mm	1	1.5	2	3	4
W14×233	W360×347	0.146	25	25	25	30	40
W14×211	W360×314	0.133	25	25	25	30	40
W14×193	W360×287	0.123	25	25	25	30	40
W14×176	W360×262	0.113	25	25	25	30	40
W14×159	W360×237	0.103	25	25	25	30	45
W14×145	W360×216	0.094	25	25	25	30	45
W12×190	W310×283	0.144	25	25	25	30	45
W12×170	W310×253	0.130	25	25	25	30	45
W12×152	W310×226	0.118	25	25	25	35	45
W12×136	W310×202	0.106	25	25	25	35	45
W10×112	W250×167	0.104	25	25	25	40	50
W10×100	W250×149	0.094	25	25	25	40	55
W10×88	W250×131	0.084	25	25	25	40	55
W10×77	W250×115	0.074	25	25	25	40	55
W8×35	W200×52	0.043	25	25	35	50	65
W8×28	W200×41.7	0.039	25	25	35	55	70
W8×24	W200×35.9	0.034	25	30	35	55	70
W8×18	W200×26.6	0.028	25	30	40	60	75

- a. The tabulated thicknesses are based upon the assumed properties of structural lightweight concrete given in Table 4B.21.5.1(2).

**TABLE 4B.21.5.1(9)**  
**MINIMUM COVER (mm) FOR STEEL COLUMNS IN NORMAL-WEIGHT**  
**PRECAST COVERS<sup>a</sup> [FIGURE 4B.21.5.1(6)(a)]**

Shape Designation		W/D kg/m/mm	Fire-Resistance Rating (hours)				
in. × lb/ft	mm×kg/m		1	1.5	2	3	4
W14×233	W360×347	0.146	40	40	40	60	80
W14×211	W360×314	0.133	40	40	40	60	80
W14×193	W360×287	0.123	40	40	40	65	85
W14×176	W360×262	0.113	40	40	45	65	85
W14×159	W360×237	0.103	40	40	45	70	90
W14×145	W360×216	0.094	40	40	50	70	90
W12×190	W310×283	0.144	40	40	40	60	80
W12×170	W310×253	0.130	40	40	40	65	85
W12×152	W310×226	0.118	40	40	45	65	85
W12×136	W310×202	0.106	40	40	45	70	90
W10×112	W250×167	0.104	40	40	45	70	90
W10×100	W250×149	0.094	40	40	50	70	90
W10×88	W250×131	0.084	40	40	50	75	95
W10×77	W250×115	0.074	40	40	55	75	95
W8×35	W200×52	0.043	40	50	65	85	110
W8×28	W200×41.7	0.039	40	50	65	90	110
W8×24	W200×35.9	0.034	40	55	65	90	110
W8×18	W200×26.6	0.028	40	55	70	95	115

- a. The tabulated thicknesses are based upon the assumed properties of normal- weight concrete given in Table 4B.21.5.1(2).

**TABLE 4B.21.5.1(10)**  
**MINIMUM COVER (mm) FOR STEEL COLUMNS IN STRUCTURAL**  
**LIGHTWEIGHT PRECAST COVERS<sup>a</sup> [FIGURE 4B.21.5.1(6)(a)]**

Shape Designation		W/D kg/m/mm	Fire-Resistance Rating (hours)				
in. × lb/ft	mm×kg/m		1	1.5	2	3	4
W14×233	W360×347	0.146	40	40	40	40	60
W14×211	W360×314	0.133	40	40	40	45	60
W14×193	W360×287	0.123	40	40	40	45	65
W14×176	W360×262	0.113	40	40	40	50	65
W14×159	W360×237	0.103	40	40	40	50	65
W14×145	W360×216	0.094	40	40	40	55	70
W12×190	W310×283	0.144	40	40	40	45	60
W12×170	W310×253	0.130	40	40	40	45	60
W12×152	W310×226	0.118	40	40	40	50	65
W12×136	W310×202	0.106	40	40	40	50	70
W10×112	W250×167	0.104	40	40	40	50	70
W10×100	W250×149	0.094	40	40	40	55	70
W10×88	W250×131	0.084	40	40	40	55	75
W10×77	W250×115	0.074	40	40	40	60	75
W8×35	W200×52	0.043	40	40	50	70	90
W8×28	W200×41.7	0.039	40	40	55	75	90
W8×24	W200×35.9	0.034	40	45	55	75	95
W8×18	W200×26.6	0.028	40	45	55	80	95

- a. The tabulated thicknesses are based upon the assumed properties of structural lightweight concrete given in Table 4B.21.5.1(2).

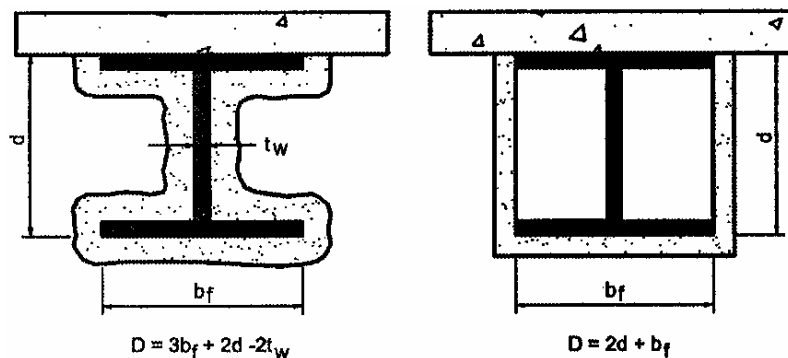


**4B.21.5.2 Structural steel beams and girders.** The fire-resistance ratings of steel beams and girders shall be based upon the size of the element and the type of protection provided in accordance with this section.

**4B.21.5.2.1 Determination of fire resistance.** These procedures establish a basis for determining resistance of structural steel beams and girders which differ in size from that specified in approved fire-resistant assemblies as a function of the thickness of fire-resistant material and the weight ( $W$ ) and heated perimeter ( $D$ ) of the beam or girder. As used in these sections,  $W$  is the average weight of a structural steel member in kilograms per linear meter. The heated perimeter,  $D$ , is the inside perimeter of the fire-resistant material in millimeters as illustrated in Figure 4B.21.5.2.

**4B.21.5.2.1.1 Weight-to-heated perimeter.** The weight-to-heated-perimeter ratios ( $W/D$ ), for both contour and box fire-resistant protection profiles, for some wide flange shapes used as beams or girders are given in Table 4B.21.5.1(4). For different shapes, the weight-to-heated-perimeter ratios ( $W/D$ ) shall be determined in accordance with the definitions given in this section.

**4B.21.5.2.1.2 Beam and girder substitutions.** Except as provided for in Section 4B.21.5.2.2, structural steel beams in approved fire-resistant assemblies shall be considered the minimum permissible size. Other beam or girder shapes shall be permitted to be substituted provided that the weight-to-heated-perimeter ratio ( $W/D$ ) of the substitute beam is equal to or greater than that of the beam specified in the approved assembly.



**FIGURE 4B.21.5.2  
DETERMINATION OF THE HEATED PERIMETER OF  
STRUCTURAL STEEL BEAMS AND GIRDERS**

**4B.21.5.2.2 Spray-applied fire-resistant materials.** The provisions in this section apply to unrestrained structural steel beams and girders protected with spray-applied fire-resistant materials. Larger or smaller unrestrained beam and girder shapes shall be permitted to be substituted for beams specified in approved unrestrained or restrained fire-resistant assemblies provided that the thickness of the fire-resistant material is adjusted in accordance with the following expression:

$$h_2 = \left[ \frac{(W_1 / D_1) + 0.60}{(W_2 / D_2) + 0.60} \right] h_1 \quad \text{(Equation 4B.-17)}$$

Where:

$h$  = Thickness of spray-applied fire-resistant material in mm

$W$  = Weight of the structural steel beam or girder in kg/m

$D$  = Heated perimeter of the structural steel beam or girder in mm

Subscript 1 refers to the beam and fire-resistant material thickness in the approved assembly.

Subscript 2 refers to the substitute beam or girder and the required thickness of fire-resistant material.

**4B.21.5.2.2.1 Minimum thickness.** Equation 4B.-17 is limited to beams with a weight-to-heated-perimeter ratio ( $W/D$ ) of 0.022 or greater. The minimum thickness of fire-resistant material shall not be less than 10 mm.

**4B.21.5.2.3 Structural steel trusses.** The fire resistance of structural steel trusses protected with fire-resistant materials spray applied to each of the individual truss elements shall be permitted to be determined in accordance with this section. The thickness of the fire-resistant material shall be determined in accordance with Section 4B.21.5.1.3. The weight-to-heated-perimeter ratio ( $W/D$ ) of truss elements which can be simultaneously exposed to fire on all sides shall be determined on the same basis as columns, as specified in Section 4B.21.5.1.1. The weight-to-heated-perimeter ratio ( $W/D$ ) of truss elements which directly support floor or roof construction shall be determined on the same basis as beams and girders, as specified in Section 4B.21.5.2.1.

**CHAPTER 5**  
**GENERAL PRECAUTIONS AGAINST FIRE, EMERGENCY**  
**PLANNING AND PREPAREDNESS FIRE SERVICE FEATURES**  
**BUILDING SERVICES AND SYSTEMS**

**SECTION 5A**  
**GENERAL PRECAUTIONS AGAINST FIRE**

**SECTION 5A.1**  
**GENERAL**

- 5A.1.1 Scope.** The provisions of this section shall govern the occupancy and maintenance of all structures and premises for precautions against fire and the spread of fire.
- 5A.1.2 Permits.** Permits shall be required as set forth in SBC 100 for the activities or uses regulated by Sections 5A.6, 5A.7, 5A.8.3, 5A.8.4, 5A.8.5 and 5A.15.

**SECTION 5A.2**  
**DEFINITIONS**

- 5A.2.1 Definitions.** The following words and terms shall, for the purposes of this section and as used elsewhere in these code requirements, have the meanings shown herein.

**BONFIRE.** An outdoor fire utilized for ceremonial purposes.

**HI-BOY.** A cart used to transport hot roofing materials on a roof.

**OPEN BURNING.** The burning of materials wherein products of combustion are emitted directly into the ambient air without passing through a stack or chimney from an enclosed chamber. Open burning does not include road flares, smudge pots and similar devices associated with safety or occupational uses typically considered open flames or recreational fires. For the purpose of this definition, a chamber shall be regarded as enclosed when, during the time combustion occurs, only apertures, ducts, stacks, flues or chimneys necessary to provide combustion air and permit the escape of exhaust gas are open.

**POWERED INDUSTRIAL TRUCK.** A forklift, tractor, platform lift truck or motorized hand truck powered by an electrical motor or internal combustion engine. Powered industrial trucks do not include farm vehicles or automotive vehicles for highway use.

**RECREATIONAL FIRE.** An outdoor fire burning materials other than rubbish where the fuel being burned is not contained in an incinerator, outdoor fireplace, barbeque grill or barbeque pit and has a total fuel area of 900 mm or less in diameter and 0.6 m or less in height for pleasure, ceremonial, cooking, warmth or similar purposes.

**SECTION 5A.3**  
**ASPHALT KETTLES**

- 5A.3.1 Transporting.** Asphalt (tar) kettles shall not be transported over any highway, road or street when the heat source for the kettle is operating.

**Exception:** Asphalt (tar) kettles in the process of patching road surfaces.

- 5A.3.2 Location.** Asphalt (tar) kettles shall not be located within 6.1 m of any combustible material, combustible building surface or any building opening and within a controlled area identified by the use of traffic cones, barriers or other approved means. Asphalt (tar) kettles and pots shall not be utilized inside or on the roof of a building or structure. Roofing kettles and operating asphalt (tar) kettles shall not block means of egress, gates, roadways or entrances.
- 5A.3.3 Location of fuel containers.** Fuel containers shall be located at least 3 m from the burner.  
**Exception:** Containers properly insulated from heat or flame are allowed to be within 0.6 m of the burner.
- 5A.3.4 Attendant.** An operating kettle shall be attended by a minimum of one employee knowledgeable of the operations and hazards. The employee shall be within 30.5 m of the kettle and have the kettle within sight. Ladders or similar obstacles shall not form a part of the route between the attendant and the kettle.
- 5A.3.5 Fire extinguishers.** There shall be a portable fire extinguisher complying with Section 7.6 and with a minimum 40-B:C rating within 7.6 m of each asphalt (tar) kettle during the period such kettle is being utilized, and one additional portable fire extinguisher with a minimum 40-B:C rating on the roof being covered.
- 5A.3.6 Lids.** Asphalt (tar) kettles shall be equipped with tight-fitting lids.
- 5A.3.7 Hi-boys.** Hi-boys shall be constructed of noncombustible materials. Hi-boys shall be limited to a capacity of 208 L. Fuel sources or heating elements shall not be allowed as part of a hi-boy.
- 5A.3.8 Roofing kettles.** Roofing kettles shall be constructed of noncombustible materials.
- 5A.3.9 Fuel containers under air pressure.** Fuel containers that operate under air pressure shall not exceed 76 L in capacity and shall be approved.

## SECTION 5A.4 COMBUSTIBLE WASTE MATERIAL

- 5A.4.1 Waste accumulation prohibited.** Combustible waste material creating a fire hazard shall not be allowed to accumulate in buildings or structures or upon premises.
- 5A.4.1.1 Waste material.** Accumulations of wastepaper, wood, hay, straw, weeds, litter or combustible or flammable waste or rubbish of any type shall not be permitted to remain on a roof or in any court, yard, vacant lot, alley, parking lot, open space, or beneath a grandstand, bleacher, pier, wharf, manufactured home, recreational vehicle or other similar structure.
- 5A.4.1.2 Vegetation.** Weeds, grass, vines or other growth that is capable of being ignited and endangering property, shall be cut down and removed by the owner or occupant of the premises.
- 5A.4.1.3 Space underneath seats.** Spaces underneath grandstand and bleacher seats shall be kept free from combustible and flammable materials. Except where enclosed in not less than 1 hour fire-resistance-rated construction in accordance with the

Chapter 4, spaces underneath grandstand and bleacher seats shall not be occupied or utilized for purposes other than means of egress.

- 5A.4.2 Storage.** Storage of combustible rubbish shall not produce conditions that will create a nuisance or a hazard to the public health, safety or welfare.
- 5A.4.3 Containers.** Combustible rubbish, and waste material kept within a structure shall be stored in accordance with Sections 5A.4.3.1 through 5A.4.3.3.
- 5A.4.3.1 Spontaneous ignition.** Materials susceptible to spontaneous ignition, such as oily rags, shall be stored in a listed disposal container. Contents of such containers shall be removed and disposed of daily.
- 5A.4.3.2 Capacity exceeding 0.15 m<sup>3</sup>.** Containers with a capacity exceeding 0.15 m<sup>3</sup> shall be provided with lids. Containers and lids shall be constructed of noncombustible materials or approved combustible materials.
- 5A.4.3.3 Capacity exceeding 1.15 m<sup>3</sup>.** Dumpsters and containers with an individual capacity of 1.15 m<sup>3</sup> or more shall not be stored in buildings or placed within 1.5 m of combustible walls, openings or combustible roof eave lines.
- Exceptions:**
1. Dumpsters or containers in areas protected by an approved automatic sprinkler system complying with Chapter 7.
  2. Storage in a structure shall not be prohibited where the structure is of Type I or Type IIA construction, located not less than 3 m from other buildings and used exclusively for dumpster or container storage.

## SECTION 5A.5 IGNITION SOURCES

- 5A.5.1 Clearance from ignition sources.** Clearance between ignition sources, such as light fixtures, heaters and flame-producing devices, and combustible materials shall be maintained in an approved manner.
- 5A.5.2 Hot ashes and spontaneous ignition sources.** Hot ashes, cinders, smoldering coals or greasy or oily materials subject to spontaneous ignition shall not be deposited in a combustible receptacle, within 3 m of other combustible material including combustible walls and partitions or within 0.6 m of openings to buildings.
- Exception:** The minimum required separation distance to other combustible materials shall be 0.6 m where the material is deposited in a covered, noncombustible receptacle placed on a noncombustible floor, ground surface or stand.
- 5A.5.3 Open-flame warning devices.** Open-flame warning devices shall not be used along an excavation, road, or any place where the dislodgment of such device might permit the device to roll, fall or slide on to any area or land containing combustible material.
- 5A.5.4 Deliberate or negligent burning.** It shall be unlawful to deliberately or through negligence set fire to or cause the burning of combustible material in such a manner as to endanger the safety of persons or property.

## SECTION 5A.6 MOTION PICTURE FILM AND SCREENS

- 5A.6.1 Motion picture projection rooms.** Electric arc, xenon or other light source projection equipment which develops hazardous gases, dust or radiation and the projection of ribbon-type cellulose nitrate film, regardless of the light source used in projection, shall be operated within a motion picture projection room complying with Section 2.22 of SBC 201.
- 5A.6.2 Cellulose nitrate film storage.** Storage of cellulose nitrate film shall be in accordance with NFPA 40.

## SECTION 5A.7 OPEN BURNING AND RECREATIONAL FIRES

- 5A.7.1 General.** A person shall not kindle or maintain or authorize to be kindled or maintained any open burning unless conducted and approved in accordance with this section.
- 5A.7.2 Permit required.** A permit shall be obtained from the building official in accordance with SBC 100 prior to kindling a fire for recognized silvicultural or range or wildlife management practices, prevention or control of disease or pests, or a bonfire. Application for such approval shall only be presented by and permits issued to the owner of the land upon which the fire is to be kindled.
- 5A.7.2.1 Authorization.** Where required local law or regulations, open burning shall only be permitted with prior approval from the local air and water quality management authority, provided that all conditions specified in the authorization are followed.
- 5A.7.2.2 Prohibited open burning.** Open burning that will be offensive or objectionable because of smoke or odor emissions when atmospheric conditions or local circumstances make such fires hazardous shall be prohibited. The building official is authorized to order the extinguishment by the permit holder or the Civil Defence of open burning which creates or adds to a hazardous or objectionable situation.
- 5A.7.3 Location.** The location for open burning shall not be less than 15.2 m from any structure, and provisions shall be made to prevent the fire from spreading to within 15.2 m of any structure.
- Exceptions:**
1. Fires in approved containers that are not less than 4.6 m from a structure.
  2. The minimum required distance from a structure shall be 7.6 m where the pile size is 900 mm or less in diameter and 0.6 m or less in height.
- 5A.7.3.1 Bonfires.** A bonfire shall not be conducted within 15.2 m of a structure or combustible material unless the fire is contained in a barbecue pit. Conditions which could cause a fire to spread within 15.2 m of a structure shall be eliminated prior to ignition.
- 5A.7.3.2 Recreational fires.** Recreational fires shall not be conducted within 7.6 m of a structure or combustible material. Conditions which could cause a fire to spread within 7.6 m of a structure shall be eliminated prior to ignition.
- 5A.7.4 Attendance.** Open burning, bonfires or recreational fires shall be constantly attended until the fire is extinguished. A minimum of one portable fire extinguisher complying with Section 7.6 with a minimum 4-A rating or other approved on-site fire-extinguishing equipment, such as dirt, sand, water barrel,

garden hose or water truck, shall be available for immediate utilization.

## SECTION 5A.8 OPEN FLAMES

**5A.8.1 General.** This section shall control open flames, fire and burning on all premises.

**5A.8.2 Where prohibited.** A person shall not take or utilize an open flame or light in a structure, vessel, boat or other place where highly flammable, combustible or explosive material is utilized or stored. Lighting appliances shall be well-secured in a glass globe and wire mesh cage or a similar approved device.

**5A.8.2.1 Throwing or placing sources of ignition.** No person shall throw or place, or cause to be thrown or placed, a lighted match, cigar, cigarette, matches, or other flaming or glowing substance or object on any surface or article where it can cause an unwanted fire.

**5A.8.3 Open flame.** A person shall not utilize or allow to be utilized, an open flame in connection with a public meeting or gathering for purposes of deliberation, worship, entertainment, amusement, instruction, education, recreation, awaiting transportation or similar purpose in assembly or educational occupancies without first obtaining a permit in accordance with SBC 100.

**5A.8.3.1 Open-flame cooking devices.** Charcoal burners and other open-flame cooking devices shall not be operated on combustible balconies or within 3 m of combustible construction.

**Exceptions:**

1. One- and two-family dwellings.
2. Where buildings, balconies and decks are protected by an automatic sprinkler system.

**5A.8.3.1.1 Liquefied-petroleum-gas-fueled cooking devices.** LP-gas burners having an LP-gas container with a water capacity greater than 1.14 kg shall not be located on combustible balconies or within 3 m of combustible construction.

**Exception:** One- and two-family dwellings.

**5A.8.3.2 Open-flame decorative devices.** Open-flame decorative devices shall comply with all of the following restrictions:

1. Class I and Class II liquids and LP-gas shall not be used.
2. Liquid or solid-fueled lighting devices containing more than 237 ml of fuel must self-extinguish and not leak fuel at a rate of more than 1.26 ml per minute if tipped over.
3. The device or holder shall be constructed to prevent the spillage of liquid fuel or wax at the rate of more than 1.26 ml per minute when the device or holder is not in an upright position.
4. The device or holder shall be designed so that it will return to the upright position after being tilted to an angle of 45 degrees from vertical.

**Exception:** Devices that self-extinguish if tipped over and do not spill fuel or wax at the rate of more than 1.26 ml per minute if tipped over.

5. The flame shall be enclosed except where openings on the side are not more than 9.5 mm diameter or where openings are on the top and the distance to the top is such that a piece of tissue paper placed on the top will not ignite in 10 seconds.

6. Chimneys shall be made of noncombustible materials and securely attached to the open-flame device.

**Exception:** A chimney is not required to be attached to any open-flame device

that will self-extinguish if the device is tipped over.

7. Fuel canisters shall be safely sealed for storage.
8. Storage and handling of combustible liquids shall be in accordance with Chapter 32.
9. Shades, where used, shall be made of noncombustible materials and securely attached to the open-flame device holder or chimney.
10. Candelabras with flame-lighted candles shall be securely fastened in place to prevent overturning, and shall be located away from occupants using the area and away from possible contact with drapes, curtains or other combustibles.

**5A.8.3.3 Location near combustibles.** Open flames such as from candles, lanterns, kerosene heaters, and gas-fired heaters shall not be located on or near decorative material or similar combustible materials.

**5A.8.3.4 Aisles and exits.** Candles shall be prohibited in areas where occupants stand, or in an aisle or exit.

**5A.8.3.5 Ceremonies.** When, in the opinion of the building official, adequate safeguards have been taken, participants in ceremonies are allowed to carry hand-held candles, and sandal wood burner. Hand-held candles and sandal wood burner shall not be passed from one person to another while lighted.

**5A.8.3.6 Theatrical performances.** Where approved, open-flame devices used in conjunction with theatrical performances are allowed to be used when adequate safety precautions have been taken in accordance with NFPA 160.

**5A.8.3.7 Group A occupancies.** Open-flame devices shall not be used in a Group A occupancy.

**Exceptions:**

1. Open-flame devices are allowed to be used in the following situations, provided approved precautions are taken to prevent ignition of a combustible material or injury to occupants:
  - 1.1 Where necessary for ceremonial purposes in accordance with Section 5A.8.3.5.
  - 1.2 On stages and platforms as a necessary part of a performance in accordance with Section 5A.8.3.6.
  - 1.3 Where candles on tables are securely supported on substantial noncombustible bases and the candle flames are protected.
2. Heat-producing equipment complying with Chapter 6 and the SBC 501.
3. Gas lights are allowed to be used provided adequate precautions satisfactory to the building official are taken to prevent ignition of combustible materials.

**5A.8.4 Torches for removing paint.** Persons utilizing a torch or other flame-producing device for removing paint from a structure shall provide a minimum of one portable fire extinguisher complying with Section 7.6 and with a minimum 4-A rating, two portable fire extinguishers, each with a minimum 2-A rating, or a water hose connected to the water supply on the premises where such burning is done. The person doing the burning shall remain on the premises 1 hour after the torch or flame-producing device is utilized.

**5A.8.4.1 Permit.** A permit in accordance with SBC 100 shall be secured from the building official prior to the utilization of a torch or flame-producing device to remove paint from a structure.

**5A.8.5 Open-flame devices.** Torches and other devices, machines or processes liable to start or cause fire shall not be operated or used in or upon hazardous fire areas, except by a permit in accordance with SBC 100 secured from the building official.  
**Exception:** Use within inhabited premises or designated campsites which are a



minimum of 9.1 m from grass, grain, brush or forest-covered areas.

- 5A.8.5.1 Signals and markers.** Flame-employing devices, such as lanterns or kerosene road flares, shall not be operated or used as a signal or marker in or upon hazardous fire areas.

**Exception:** The proper use of fuses at the scenes of emergencies or as required by standard railroad operating procedures.

- 5A.8.5.2 Portable fueled open-flame devices.** Portable open-flame devices fueled by flammable or combustible gases or liquids shall be enclosed or installed in such a manner as to prevent the flame from contacting combustible material.

**Exceptions:**

1. LP-gas-fueled devices used for sweating pipe joints or removing paint in accordance with Chapter 36.
2. Cutting and welding operations in accordance with Chapter 24.
3. Torches or flame-producing devices in accordance with Section 5A.8.4.
4. Candles and open-flame decorative devices in accordance with Section 5A.8.3.

## SECTION 5A.9 POWERED INDUSTRIAL TRUCKS

- 5A.9.1 General.** Powered industrial trucks shall be operated and maintained in accordance with this section.
- 5A.9.2 Battery chargers.** Battery chargers shall be of an approved type. Combustible storage shall be kept a minimum of 900 mm from battery chargers. Battery charging shall not be conducted in areas accessible to the public.
- 5A.9.3 Ventilation.** Ventilation shall be provided in an approved manner in battery-charging areas to prevent a dangerous accumulation of flammable gases.
- 5A.9.4 Fire extinguishers.** Battery-charging areas shall be provided with a fire extinguisher complying with Section 7.6 having a minimum 4-A:20-B:C rating within 6.1 m of the battery charger.
- 5A.9.5 Refueling.** Powered industrial trucks using liquid fuel or LP-gas shall be refueled outside of buildings or in areas specifically approved for that purpose and in accordance with Chapter 32 or 36.
- 5A.9.6 Repairs.** Repairs to fuel systems, electrical systems and repairs utilizing open flame or welding shall be done in approved locations outside of buildings or in areas specifically approved for that purpose.

## SECTION 5A.10 SMOKING

- 5A.10.1 General.** The smoking or carrying of a lighted pipe, cigar, cigarette or any other type of smoking paraphernalia or material is prohibited in the areas indicated in this section.
- 5A.10.2 Prohibited areas.** Smoking shall be prohibited where conditions are such as to make smoking a hazard, and in spaces where flammable or combustible materials are stored or handled.

- 5A.10.3 “No Smoking” signs.** The building official is authorized to order the posting of “No Smoking” signs in a conspicuous location in each structure or location in which smoking is prohibited. The content, lettering, size, color and location of required “No Smoking” signs shall be approved.
- 5A.10.4 Removal of signs prohibited.** A posted “No Smoking” sign shall not be obscured, removed, defaced, mutilated or destroyed.
- 5A.10.5 Compliance with “No Smoking” signs.** Smoking shall not be permitted nor shall a person smoke, throw or deposit any lighted or smoldering substance in any place where “No Smoking” signs are posted.
- 5A.10.6 Ash trays.** Where smoking is permitted, suitable noncombustible ashtrays or match receivers shall be provided on each table and at other appropriate locations.
- 5A.10.7 Burning objects.** Lighted matches, cigarettes, cigars or other burning object shall not be discarded in such a manner that could cause ignition of other combustible material.
- 5A.10.8 Hazardous environmental conditions.** When the building official determines that hazardous environmental conditions necessitate controlled use of smoking materials, the ignition or use of such materials in mountainous, brush-covered or forest-covered areas or other designated areas is prohibited except in approved designated smoking areas.

## SECTION 5A.11 VACANT PREMISES

- 5A.11.1 General.** Temporarily unoccupied buildings, structures, premises or portions thereof, including tenant spaces, shall be safeguarded and maintained in accordance with this section.
- 5A.11.1.1 Abandoned premises.** Buildings, structures and premises for which an owner cannot be identified or located by dispatch of a certificate of mailing to the last known or registered address, which persistently or repeatedly become unprotected or unsecured, which have been occupied by unauthorized persons or for illegal purposes, or which present a danger of structural collapse or fire spread to adjacent properties shall be considered abandoned, declared unsafe and abated by demolition or rehabilitation in accordance with the SBC 100.
- 5A.11.1.2 Tenant spaces.** Storage and lease plans required by these code requirements shall be revised and updated to reflect temporary or partial vacancies.
- 5A.11.2 Safeguarding vacant premises.** Temporarily unoccupied buildings, structures, premises or portions thereof shall be secured and protected in accordance with this section.
- 5A.11.2.1 Security.** Exterior openings and interior openings accessible to other tenants or unauthorized persons shall be boarded, locked, blocked or otherwise protected to prevent entry by unauthorized individuals.
- 5A.11.2.2 Fire protection.** Fire alarm, sprinkler and standpipe systems shall be maintained in an operable condition at all times.
- Exceptions:**
1. When the premises have been cleared of all combustible materials and debris and, in the opinion of the building official, the type of construction, fire

separation distance and security of the premises do not create a fire hazard.

2. Where buildings will not be heated and fire protection systems will be exposed to freezing temperatures, fire alarm and sprinkler systems are permitted to be placed out of service and standpipes are permitted to be maintained as dry systems (without an automatic water supply) provided the building has no contents or storage, and windows, doors and other openings are secured to prohibit entry by unauthorized persons.

**5A.11.2.3 Fire separation.** Fire-resistance-rated partitions, fire barriers, and fire walls separating vacant tenant spaces from the remainder of the building shall be maintained. Openings, joints, and penetrations in fire-resistance-rated assemblies shall be protected in accordance with Chapter 4.

**5A.11.3 Removal of combustibles.** Persons owning, or in charge or control of, a vacant building or portion thereof, shall remove from all accumulations of combustible materials, flammable or combustible waste or rubbish and shall securely lock or otherwise secure doors, windows and other openings to prevent entry by unauthorized persons. The premises shall be maintained clear of waste or hazardous materials.

**Exceptions:**

1. Buildings or portions of buildings undergoing additions, alterations, repairs, or change of occupancy in accordance with the SBC 201, where waste is controlled and removed as required by Section 5A.4.
2. Seasonally occupied buildings.

**5A.11.4 Removal of hazardous materials.** Persons owning or having charge or control of a vacant building containing hazardous materials regulated by Chapter 25 shall comply with the facility closure requirements of Section 25.1.6.

## **SECTION 5A.12 VEHICLE IMPACT PROTECTION**

**5A.12.1 General.** Vehicle impact protection required by these code requirements shall be provided by posts that comply with Section 5A.12.2 or by other approved physical barriers that comply with Section 5A.12.3.

**5A.12.2 Posts.** Guard posts shall comply with all of the following requirements:

1. Constructed of steel not less than 100 mm in diameter and concrete filled.
2. Spaced not more than 1.2 m between posts on center.
3. Set not less than 900 mm deep in a concrete footing of not less than a 381 mm diameter.
4. Set with the top of the posts not less than 900 mm above ground.
5. Located not less than 900 mm from the protected object.

**5A.12.3 Other barriers.** Physical barriers shall be a minimum of 900 mm in height and shall resist a force of 53,375 N applied 900 mm above the adjacent ground surface.

## **SECTION 5A.13 FUELED EQUIPMENT**

**5A.13.1 Fueled equipment.** Fueled equipment, including but not limited to motorcycles, mopeds, lawn-care equipment and portable cooking equipment, shall not be stored, operated or repaired within a building.

**Exceptions:**

1. Buildings or rooms constructed for such use in accordance with the SBC.
2. Where allowed by Section 5A.13.

**5A.13.1.1 Removal.** The building official is authorized to require removal of fueled equipment from locations where the presence of such equipment is determined by the building official to be hazardous.

**5A.13.2 Group R occupancies.** Vehicles powered by flammable liquids, Class II combustible liquids, or compressed flammable gases shall not be stored within the living space of Group R buildings and shall be separated from other occupancies in accordance with the SBC.

## **SECTION 5A.14 INDOOR DISPLAYS**

**5A.14.1 General.** Indoor displays constructed within any occupancy shall comply with Sections 5A.14.2 through 5A.14.4.

**5A.14.2 Fixtures and displays.** Fixtures and displays of goods for sale to the public shall be arranged so as to maintain free, immediate and unobstructed access to exits as required by Chapter 8.

**5A.14.3 Highly combustible goods.** The display of highly combustible goods, including but not limited to fireworks, flammable or combustible liquids, liquefied flammable gases, oxidizing materials, pyroxylin plastics and agricultural goods, in main exit access aisles, corridors, covered malls, or within 1.5 m of entrances to exits and exterior exit doors is prohibited when a fire involving such goods would rapidly prevent or obstruct egress.

**5A.14.4 Vehicles.** Liquid or gas-fueled vehicles, boats or other motorcraft shall not be located indoors except as follows:

1. Batteries are disconnected.
2. Fuel in fuel tanks does not exceed one-quarter tank or 19 L (whichever is least).
3. Fuel tanks and fill openings are closed and sealed to prevent tampering.
4. Vehicles, boats or other motorcraft equipment are not fueled or defueled within the building.

## **SECTION 5A.15 MISCELLANEOUS COMBUSTIBLE MATERIALS STORAGE**

**5A.15.1 General.** Storage, use and handling of miscellaneous combustible materials shall be in accordance with this section. A permit shall be obtained in accordance with SBC 100.

**5A.15.2 Storage in buildings.** Storage of combustible materials in buildings shall be orderly. Storage shall be separated from heaters or heating devices by distance or shielding so that ignition cannot occur.

**5A.15.2.1 Ceiling clearance.** Storage shall be maintained 0.6 m or more below the ceiling in nonsprinklered areas of buildings or a minimum of 457 mm below sprinkler head deflectors in sprinklered areas of buildings.

**5A.15.2.2 Means of egress.** Combustible materials shall not be stored in exits or exit

enclosures.

**5A.15.2.3 Equipment rooms.** Combustible material shall not be stored in boiler rooms, mechanical rooms or electrical equipment rooms.

**5A.15.2.4 Attic, under-floor and concealed spaces.** Attic, under-floor and concealed spaces used for storage of combustible materials shall be protected on the storage side as required for 1-hour fire-resistance-rated construction. Openings shall be protected by assemblies that are self-closing and are of noncombustible construction or solid wood core not less than 44.5 mm in thickness. Storage shall not be placed on exposed joists.

**Exceptions:**

1. Areas protected by approved automatic sprinkler systems.
2. Group R-3 and Group U occupancies.

**5A.15.3 Outside storage.** Outside storage of combustible materials shall not be located within 3 m of a property line.

**Exceptions:**

1. The separation distance is allowed to be reduced to 900 mm for storage not exceeding 1.8 m in height.
2. The separation distance is allowed to be reduced when the building official determines that no hazard to the adjoining property exists.

**5A.15.3.1 Storage beneath overhead projections from buildings.** Combustible materials stored or displayed outside of buildings that are protected by automatic sprinklers shall not be stored or displayed under nonsprinklered eaves, canopies or other projections or overhangs.

**5A.15.3.2 Height.** Storage in the open shall not exceed 6.1 m in height.

## SECTION 5B EMERGENCY PLANNING AND PREPAREDNESS

### SECTION 5B.1 GENERAL

**5B.1.1 Scope.** Reporting of emergencies, coordination with emergency response forces, emergency plans, and procedures for managing or responding to emergencies shall comply with the provisions of this section.

**Exception:** Firms that have approved on-premises fire-fighting organizations and that are in compliance with approved procedures for fire reporting.

**5B.1.2 Approval.** Where required by these code requirements, fire safety plans, emergency procedures, and employee training programs shall be approved by the building official.

**5B.1.3 Emergency forces notification.** In the event an unwanted fire occurs on a property, the owner or occupant shall immediately report such condition to the fire department. Building employees and tenants shall implement the appropriate emergency plans and procedures. No person shall, by verbal or written directive, require any delay in the reporting of a fire to the fire department.

**5B.1.3.1 Making false report.** It shall be unlawful for a person to give, signal, or transmit a false alarm.

**5B.1.3.2 Alarm activations.** Upon activation of a fire alarm signal, employees or staff shall immediately notify the fire department.

- 5B.1.3.3 Emergency evacuation drills.** Nothing in this section shall prohibit the sounding of a fire alarm signal for the carrying out of an emergency evacuation drill in accordance with the provisions of Section 5B.5.
- 5B.1.4 Interference with fire department operations.** It shall be unlawful to interfere with, attempt to interfere with, conspire to interfere with, obstruct or restrict the mobility of or block the path of travel of a fire department emergency vehicle in any way, or to interfere with, attempt to interfere with, conspire to interfere with, obstruct or hamper any fire department operation.
- 5B.1.5 Security device.** Any security device or system that emits any medium that could obscure a means of egress in any building, structure or premise shall be prohibited.

## SECTION 5B.2 DEFINITIONS

- 5B.2.1 Definition.** The following word and term shall, for the purposes of this section and as used elsewhere in these code requirements, have the meaning shown herein.

**EMERGENCY EVACUATION DRILL.** An exercise performed to train staff and occupants and to evaluate their efficiency and effectiveness in carrying out emergency evacuation procedures.

## SECTION 5B.3 PUBLIC ASSEMBLAGES AND EVENTS

- 5B.3.1 General.** When, in the opinion of the building official, it is essential for public safety in a place of assembly or any other place where people congregate, because of the number of persons, or the nature of the performance, exhibition, display, contest or activity, the owner, agent or lessee shall provide one or more fire watch personnel, as required and approved, to remain on duty during the times such places are open to the public, or when such activity is being conducted. The fire watch personnel shall keep diligent watch for fires, obstructions to means of egress and other hazards during the time such place is open to the public or such activity is being conducted and take prompt measures for remediation of hazards, extinguishment of fires that occur and assist in the evacuation of the public from the structures.
- 5B.3.1.1 Public safety plan.** In other than Group A or E occupancies, where the building official determines that an indoor or outdoor gathering of persons has an adverse impact on public safety through diminished access to buildings, structures, fire hydrants and fire apparatus access roads or where such gatherings adversely affect public safety services of any kind, the building official shall have the authority to order the development of, or prescribe a plan for, the provision of an approved level of public safety.
- 5B.3.1.2 Contents.** The public safety plan, where required by Section 5B.3.1.1, shall address such items as emergency vehicle ingress and egress, fire protection, emergency medical services, public assembly areas and the directing of both attendees and vehicles (including the parking of vehicles), vendor and food concession distribution, and the need for the presence of law enforcement, and fire and emergency medical services personnel at the event.

## SECTION 5B.4

### FIRE SAFETY AND EVACUATION PLANS

- 5B.4.1 General.** Fire safety and evacuation plans shall comply with the requirements of this section.
- 5B.4.2 Where required.** An approved fire safety and evacuation plan shall be prepared and maintained for the following occupancies and buildings.
1. Group A, other than Group A occupancies used exclusively for purposes of mosques that have an occupant load less than 2,000.
  2. Group E.
  3. Group H.
  4. Group I.
  5. Group R-1.
  6. Group R-4.
  7. High-rise buildings.
  8. Group M buildings having an occupant load of 500 or more persons or more than 100 persons above or below the lowest level of exit discharge.
  9. Covered malls exceeding 4,645 m<sup>2</sup> in aggregate floor area.
  10. Underground buildings.
  11. Buildings with an atrium and having an occupancy in Group A, E or M.
- 5B.4.3 Contents.** Fire safety and evacuation plan contents shall be in accordance with Sections 5B.4.3.1 and 5B.4.3.2.
- 5B.4.3.1 Fire evacuation plans.** Fire evacuation plans shall include the following:
1. Emergency egress or escape routes and whether evacuation of the building is to be complete or, where approved, by selected floors or areas only.
  2. Procedures for employees who must remain to operate critical equipment before evacuating.
  3. Procedures for accounting for employees and occupants after evacuation has been completed.
  4. Identification and assignment of personnel responsible for rescue or emergency medical aid.
  5. The preferred and any alternative means of notifying occupants of a fire or emergency.
  6. The preferred and any alternative means of reporting fires and other emergencies to the fire department or designated emergency response organization.
  7. Identification and assignment of personnel who can be contacted for further information or explanation of duties under the plan.
  8. A description of the emergency voice/alarm communication system alert tone and preprogrammed voice messages, where provided.
- 5B.4.3.2 Fire safety plans.** Fire safety plans shall include the following:
1. The procedure for reporting a fire or other emergency.
  2. The life safety strategy and procedures for notifying, relocating, or evacuating occupants.
  3. Site plans indicating the following:
    - 3.1 The occupancy assembly point.
    - 3.2 The locations of fire hydrants.
    - 3.3 The normal routes of fire department vehicle access.
  4. Floor plans identifying the locations of the following:
    - 4.1 Exits.

- 4.2 Primary evacuation routes.
- 4.3 Secondary evacuation routes.
- 4.4 Accessible egress routes.
- 4.5 Areas of refuge.
- 4.6 Manual fire alarm boxes.
- 4.7 Portable fire extinguishers.
- 4.8 Occupant-use hose stations.
- 4.9 Fire alarm annunciators and controls.
- 5. A list of major fire hazards associated with the normal use and occupancy of the premises, including maintenance and housekeeping procedures.
- 6. Identification and assignment of personnel responsible for maintenance of systems and equipment installed to prevent or control fires.
- 7. Identification and assignment of personnel responsible for maintenance, housekeeping and controlling fuel hazard sources.

**5B.4.4 Maintenance.** Fire safety and evacuation plans shall be reviewed or updated annually or as necessitated by changes in staff assignments, occupancy, or the physical arrangement of the building.

**5B.4.5 Availability.** Fire safety and evacuation plans shall be available in the workplace for reference and review by employees, and copies shall be furnished to the building official for review upon request.

## SECTION 5B.5 EMERGENCY EVACUATION DRILLS

**5B.5.1 General.** Emergency evacuation drills complying with the provisions of this section shall be conducted in the occupancies listed in Section 5B.4.2 or when required by the building official. Drills shall be designed in cooperation with the local authorities.

**5B.5.2 Frequency.** Required emergency evacuation drills shall be held at the intervals specified in Table 5B.5.2 or more frequently where necessary to familiarize all occupants with the drill procedure.

**5B.5.3 Leadership.** Responsibility for the planning and conduct of drills shall be assigned to competent persons designated to exercise leadership.

**5B.5.4 Time.** Drills shall be held at unexpected times and under varying conditions to simulate the unusual conditions that occur in case of fire.

**5B.5.5 Record keeping.** Records shall be maintained of required emergency evacuation drills and include the following information:

- 1. Identity of the person conducting the drill.
- 2. Date and time of the drill.
- 3. Notification method used.
- 4. Staff members on duty and participating.
- 5. Number of occupants evacuated.
- 6. Special conditions simulated.
- 7. Problems encountered.
- 8. Weather conditions when occupants were evacuated.
- 9. Time required to accomplish complete evacuation.



- 5B.5.6 Notification.** Where required by the building official, prior notification of emergency evacuation drills shall be given to the building official.

**TABLE 5B.5.2  
FIRE AND EVACUATION DRILL FREQUENCY AND  
PARTICIPATION**

<b>GROUP OR OCCUPANCY</b>	<b>FREQUENCY</b>	<b>PARTICIPATION</b>
Group A	Quarterly	Employees
Group E	Monthly <sup>a</sup>	All occupants
Group I	Quarterly on each shift	Employees <sup>b</sup>
Group R-1	Quarterly on each shift	Employees
Group R-4	Quarterly on each shift	Employees <sup>b</sup>

- a. The frequency shall be allowed to be modified in accordance with Section 5B.8.3.2.
- b. Fire and evacuation drills in residential care assisted living facilities shall include complete evacuation of the premises in accordance with Section 5B.8.10.5. Where occupants receive habilitation or rehabilitation training, fire prevention and fire safety practices shall be included as part of the training program.

- 5B.5.7 Initiation.** Where a fire alarm system is provided, emergency evacuation drills shall be initiated by activating the fire alarm system.

- 5B.5.8 Accountability.** As building occupants arrive at the assembly point, efforts shall be made to determine if all occupants have been successfully evacuated or have been accounted for.

- 5B.5.9 Recall and reentry.** An electrically or mechanically operated signal used to recall occupants after an evacuation shall be separate and distinct from the signal used to initiate the evacuation. The recall signal initiation means shall be manually operated and under the control of the person in charge of the premises or the official in charge of the incident. No one shall reenter the premises until authorized to do so by the official in charge.

## **SECTION 5B.6 EMPLOYEE TRAINING AND RESPONSE PROCEDURES**

- 5B.6.1 General.** Employees in the occupancies listed in Section 5B.4.2 shall be trained in the fire emergency procedures described in their fire evacuation and fire safety plans. Training shall be based on these plans and as described in Section 5B.4.3.

- 5B.6.2 Frequency.** Employees shall receive training in the contents of fire safety and evacuation plans and their duties as part of new employee orientation and at least annually thereafter. Records shall be kept and made available to the building official upon request.

- 5B.6.3 Employee training program.** Employees shall be trained in fire prevention, evacuation and fire safety in accordance with Sections 5B.6.3.1 through 5B.6.3.3.

- 5B.6.3.1 Fire prevention training.** Employees shall be apprised of the fire hazards of the

materials and processes to which they are exposed. Each employee shall be instructed in the proper procedures for preventing fires in the conduct of their assigned duties.

**5B.6.3.2 Evacuation training.** Employees shall be familiarized with the fire alarm and evacuation signals, their assigned duties in the event of an alarm or emergency, evacuation routes, areas of refuge, exterior assembly areas, and procedures for evacuation.

**5B.6.3.3 Fire safety training.** Employees assigned fire-fighting duties shall be trained to know the locations and proper use of portable fire extinguishers or other manual fire-fighting equipment and the protective clothing or equipment required for its safe and proper use.

## **SECTION 5B.7 HAZARD COMMUNICATION**

**5B.7.1 General.** The provisions of Sections 5B.7.2 through 5B.7.7 shall be applicable where hazardous materials subject to permits under Section 25.1.5 are located on the premises or where required by the building official.

**5B.7.2 Material Safety Data Sheets.** Material Safety Data Sheets (MSDS) for all hazardous materials shall be readily available on the premises.

**5B.7.3 Identification.** Individual containers of hazardous materials, cartons or packages shall be marked or labeled in accordance with applicable local regulations. Buildings, rooms and spaces containing hazardous materials shall be identified by hazard warning signs in accordance with Section 25.3.5.

**5B.7.4 Training.** Persons responsible for the operation of areas in which hazardous materials are stored, dispensed, handled or used shall be familiar with the chemical nature of the materials and the appropriate mitigating actions necessary in the event of a fire, leak or spill. Responsible persons shall be designated and trained to be liaison personnel for the fire department. These persons shall aid the fire department in preplanning emergency responses and identification of the locations where hazardous materials are located, and shall have access to Material Safety Data Sheets and be knowledgeable in the site emergency response procedures.

**5B.7.5 Hazardous Materials Inventory Statement.** Where required by the building official, each application for a permit shall include a Hazardous Materials Inventory Statement (HMIS) in accordance with Section 25.1.5.2.

**5B.7.6 Hazardous Materials Management Plan.** Where required by the building official, each application for a permit shall include a Hazardous Materials Management Plan (HMMP) in accordance with Section 25.1.5.1. The building official is authorized to accept a similar plan required by other regulations.

**5B.7.7 Facility closure plans.** The permit holder or applicant shall submit to the building official a facility closure plan in accordance with Section 25.1.6.3 to terminate storage, dispensing, handling or use of hazardous materials.

## SECTION 5B.8

### USE AND OCCUPANCY-RELATED REQUIREMENTS

- 5B.8.1 General.** In addition to the other requirements of this section, the provisions of this section are applicable to specific occupancies listed herein.
- 5B.8.2 Group A occupancies.** Group A occupancies shall comply with the requirements of Sections 5B.8.2.1 and 5B.8.2.2 and Sections 5B.1 through 5B.6.
- 5B.8.2.1 Seating plan.** The fire safety and evacuation plans for assembly occupancies shall include the information required by Section 5B.4.3 and a detailed seating plan, occupant load, and occupant load limit. Deviations from the approved plans shall be allowed provided the occupant load limit for the occupancy is not exceeded and the aisles and exit access ways remain unobstructed.
- 5B.8.2.2 Announcements.** In theaters, motion picture theaters, auditoriums and similar assembly occupancies in Group A used for non-continuous programs, an audible announcement shall be made not more than 10 minutes prior to the start of each program to notify the occupants of the location of the exits to be used in the event of a fire or other emergency.  
**Exception:** In motion picture theaters, the announcement is allowed to be projected upon the screen in a manner approved by the building official.
- 5B.8.3 Group E occupancies.** Group E occupancies shall comply with the requirements of Sections 5B.8.3.1 through 5B.8.3.4 and Sections 5B.1 through 5B.6.
- 5B.8.3.1 First emergency evacuation drill.** The first emergency evacuation drill of each school year shall be conducted within 10 days of the beginning of classes.
- 5B.8.3.2 Emergency evacuation drill deferral.** In severe climates, the building official shall have the authority to modify the emergency evacuation drill frequency specified in Section 5B.5.2.
- 5B.8.3.3 Time of day.** Emergency evacuation drills shall be conducted at different hours of the day or evening, during the changing of classes, when the school is at assembly, during the recess or gymnastic periods, or during other times to avoid distinction between drills and actual fires.
- 5B.8.3.4 Assembly points.** Outdoor assembly areas shall be designated and shall be located a safe distance from the building being evacuated so as to avoid interference with fire department operations. The assembly areas shall be arranged to keep each class separate to provide accountability of all individuals.
- 5B.8.4 Group H-5 occupancies.** Group H-5 occupancies shall comply with the requirements of Sections 5B.8.4.1 through 5B.8.4.4 and Sections 5B.1 through 5B.7.
- 5B.8.4.1 Plans and diagrams.** In addition to the requirements of Section 5B.4 and Section 5B.7.6, plans and diagrams shall be maintained in approved locations indicating the approximate plan for each area, the amount and type of HPM stored, handled and used, locations of shutoff valves for HPM supply piping, emergency telephone locations and locations of exits.
- 5B.8.4.2 Plan updating.** The plans and diagrams required by Section 5B.8.4.1 shall be maintained up to date and the building official and fire department shall be informed of all major changes.
- 5B.8.4.3 Emergency response team.** Responsible persons shall be designated the on-site emergency response team and trained to be liaison personnel for the fire department. These persons shall aid the fire department in preplanning emergency responses, identifying locations where HPM is stored, handled and used, and be

familiar with the chemical nature of such material. An adequate number of personnel for each work shift shall be designated.

- 5B.8.4.4 Emergency drills.** Emergency drills of the on-site emergency response team shall be conducted on a regular basis but not less than once every three months. Records of drills conducted shall be maintained.
- 5B.8.5 Group I-1 occupancies.** Group I-1 occupancies shall comply with the requirements of Sections 5B.8.5.1 through 5B.8.5.5 and Sections 5B.1 through 5B.6.
- 5B.8.5.1 Fire safety and evacuation plan.** The fire safety and evacuation plan required by Section 5B.4 shall include special staff actions including fire protection procedures necessary for residents and shall be amended or revised upon admission of any resident with unusual needs.
- 5B.8.5.2 Staff training.** Employees shall be periodically instructed and kept informed of their duties and responsibilities under the plan. Such instruction shall be reviewed by the staff at least every two months. A copy of the plan shall be readily available at all times within the facility.
- 5B.8.5.3 Resident training.** Residents capable of assisting in their own evacuation shall be trained in the proper actions to take in the event of a fire. The training shall include actions to take if the primary escape route is blocked. Where the resident is given rehabilitation or habilitation training, training in fire prevention and actions to take in the event of a fire shall be a part of the rehabilitation training program. Residents shall be trained to assist each other in case of fire to the extent their physical and mental abilities permit them to do so without additional personal risk.
- 5B.8.5.4 Drill frequency.** Emergency evacuation drills shall be conducted at least six times per year, two times per year on each shift. Twelve drills shall be conducted in the first year of operation. Drills are not required to comply with the time requirements of Section 5B.5.4.
- 5B.8.5.5 Resident participation.** Emergency evacuation drills shall involve the actual evacuation of all residents to a selected assembly point.
- 5B.8.6 Group I-2 occupancies.** Group I-2 occupancies shall comply with the requirements of Sections 5B.8.6.1 and 5B.8.6.2 and Sections 5B.1 through 5B.6. Drills are not required to comply with the time requirements of Section 5B.5.4.
- 5B.8.6.1 Evacuation not required.** During emergency evacuation drills, the movement of patients to safe areas or to the exterior of the building is not required.
- 5B.8.6.2 Coded alarm signal.** When emergency evacuation drills are conducted after visiting hours or when patients or residents are expected to be asleep, a coded announcement is allowed instead of audible alarms.
- 5B.8.7 Group I-3 occupancies.** Group I-3 occupancies shall comply with the requirements of Sections 5B.8.7.1 through 5B.8.7.4 and Sections 5B.1 through 5B.6.
- 5B.8.7.1 Employee training.** Employees shall be instructed in the proper use of portable fire extinguishers and other manual fire suppression equipment. Training of new staff shall be provided promptly upon entrance on duty. Refresher training shall be provided at least annually.
- 5B.8.7.2 Staffing.** Group I-3 occupancies shall be provided with 24-hour staffing. Staff shall be within three floors or 91.5 m horizontal distance of the access door of each resident housing area. In Use Conditions 3, 4 and 5, as defined in Chapter 1, the arrangement shall be such that the staff involved can start release of locks necessary for emergency evacuation or rescue and initiate other necessary

emergency actions within 2 minutes of an alarm.

**Exception:** Staff shall not be required to be within three floors or 91.5 m in areas in which all locks are unlocked remotely and automatically in accordance with Section 2.21 of SBC 201.

**5B.8.7.3 Notification.** Provisions shall be made for residents in Use Conditions 3, 4 and 5, as defined in Chapter 1, to readily notify staff of an emergency.

**5B.8.7.4 Keys.** Keys necessary for unlocking doors installed in a means of egress shall be individually identifiable by both touch and sight.

**5B.8.8 Group R-1 occupancies.** Group R-1 occupancies shall comply with the requirements of Sections 5B.8.8.1 through 5B.8.8.3 and Sections 5B.1 through 5B.6.

**5B.8.8.1 Evacuation diagrams.** A diagram depicting two evacuation routes shall be posted on or immediately adjacent to every required egress door from each hotel, motel or dormitory guestroom.

**5B.8.8.2 Emergency duties.** Upon discovery of a fire or suspected fire, hotel, motel and dormitory employees shall perform the following duties:

1. Activate the fire alarm system, where provided.
2. Notify the public fire department.
3. Take other action as previously instructed.

**5B.8.8.3 Fire safety and evacuation instructions.** Information shall be provided in the fire safety and evacuation plan required by Section 5B.4 to allow guests to decide whether to evacuate to the outside, evacuate to an area of refuge, remain in place, or any combination of the three.

**5B.8.9 Group R-2 occupancies.** Group R-2 occupancies shall comply with the requirements of Sections 5B.8.9.1 through 5B.8.9.3 and Sections 5B.1 through 5B.6.

**5B.8.9.1 Emergency guide.** A fire emergency guide shall be provided which describes the location, function and use of fire protection equipment and appliances accessible to residents, including fire alarm systems, smoke alarms, and portable fire extinguishers. The guide shall also include an emergency evacuation plan for each dwelling unit.

**5B.8.9.2 Maintenance.** Emergency guides shall be reviewed and approved in accordance with Section 5B.1.2.

**5B.8.9.3 Distribution.** A copy of the emergency guide shall be given to each tenant prior to initial occupancy.

**5B.8.10 Group R-4 occupancies.** Group R-4 occupancies shall comply with the requirements of Sections 5B.8.10.1 through 5B.8.10.5 and Sections 5B.1 through 5B.6.

**5B.8.10.1 Fire safety and evacuation plan.** The fire safety and evacuation plan required by Section 5B.4 shall include special staff actions, including fire protection procedures necessary for residents, and shall be amended or revised upon admission of a resident with unusual needs.

**5B.8.10.2 Staff training.** Employees shall be periodically instructed and kept informed of their duties and responsibilities under the plan. Such instruction shall be reviewed by the staff at least every two months. A copy of the plan shall be readily available at all times within the facility.

**5B.8.10.3 Resident training.** Residents capable of assisting in their own evacuation shall be trained in the proper actions to take in the event of a fire. The training shall include actions to take if the primary escape route is blocked. Where the resident is given

rehabilitation or habilitation training, training in fire prevention and actions to take in the event of a fire shall be a part of the rehabilitation training program. Residents shall be trained to assist each other in case of fire to the extent their physical and mental abilities permit them to do so without additional personal risk.

**5B.8.10.4 Drill frequency.** Emergency evacuation drills shall be conducted at least six times per year, two times per year on each shift. Twelve drills shall be conducted in the first year of operation. Drills are not required to comply with the time requirements of Section 5B.5.4.

**5B.8.10.5 Resident participation.** Emergency evacuation drills shall involve the actual evacuation of all residents to a selected assembly point and shall provide residents with experience in exiting through all required exits. All required exits shall be used during emergency evacuation drills.

**Exception:** Actual exiting from windows shall not be required. Opening the window and signaling for help shall be an acceptable alternative.

**5B.8.11 Covered mall buildings.** Covered mall buildings shall comply with the provisions of Sections 5B.8.11.1 through 5B.8.11.3.

**5B.8.11.1 Lease plan.** A lease plan shall be prepared for each covered mall building. The plan shall include the following information in addition to that required by Section 5B.4.3.2:

1. Each occupancy, including identification of tenant.
2. Exits from each tenant space.
3. Fire protection features, including the following:
  - 3.1 Fire department connections.
  - 3.2 Fire command center.
  - 3.3 Smoke management system controls.
  - 3.4 Elevators and elevator controls.
  - 3.5 Hose valves outlets.
  - 3.6 Sprinkler and standpipe control valves.
  - 3.7 Automatic fire-extinguishing system areas.
  - 3.8 Automatic fire detector zones.
  - 3.9 Fire barriers.

**5B.8.11.1.1 Approval.** The lease plan shall be submitted to the building official for approval, and shall be maintained on site for immediate reference by responding fire service personnel.

**5B.8.11.1.2 Revisions.** The lease plans shall be revised annually or as often as necessary to keep them current. Modifications or changes in tenants or occupancies shall not be made without prior approval of the building official and building official.

**5B.8.11.2 Tenant identification.** Each occupied tenant space provided with a secondary exit to the exterior or exit corridor shall be provided with tenant identification by business name and/or address. Letters and numbers shall be posted on the corridor side of the door, be plainly legible and shall contrast with their background.

**Exception:** Tenant identification is not required for anchor stores.

**5B.8.11.3 Maintenance.** Unoccupied tenant spaces shall be:

1. Kept free from the storage of any materials.
2. Separated from the remainder of the building by partitions of at least 12.7-mm-thick gypsum board or an approved equivalent to the underside of the ceiling of the adjoining tenant spaces.
3. Without doors or other access openings other than one door that shall be kept key locked in the closed position except during that time when opened for inspection.
4. Kept free from combustible waste and bedroom-swept clean.

## **SECTION 5C FIRE SERVICE FEATURES**

### **SECTION 5C.1 GENERAL**

- 5C.1.1 Scope.** Fire service features for buildings, structures and premises shall comply with this section.
- 5C.1.2 Permits.** A permit shall be required as set forth in SBC 100.
- 5C.1.3 Construction documents.** Construction documents for proposed fire apparatus access, location of fire lanes and construction documents and hydraulic calculations for fire hydrant systems shall be submitted to the Civil Defence for review and approval prior to construction.
- 5C.1.4 Timing of installation.** When fire apparatus access roads or a water supply for fire protection is required to be installed, such protection shall be installed and made serviceable prior to and during the time of construction except when approved alternative methods of protection are provided. Temporary street signs shall be installed at each street intersection when construction of new roadways allows passage by vehicles in accordance with Section 5C.5.2.

### **SECTION 5C.2 DEFINITIONS**

- 5C.2.1 Definitions.** The following words and terms shall, for the purposes of this section and as used elsewhere in these code requirements, have the meanings shown herein.

**FIRE APPARATUS ACCESS ROAD.** A road that provides fire apparatus access from a fire station to a facility, building or portion thereof. This is a general term inclusive of all other terms such as fire lane, public street, private street, parking lot lane and access roadway.

**FIRE COMMAND CENTER.** The principal attended or unattended location where the status of the detection, alarm communications and control systems is displayed, and from which the system(s) can be manually controlled.

**CIVIL DEFENCE MASTER KEY.** A limited issue key of special or controlled design to be carried by Civil Defence officials in command which will open key boxes on specified properties.

**FIRE LANE.** A road or other passageway developed to allow the passage of fire apparatus. A fire lane is not necessarily intended for vehicular traffic other than fire apparatus.

**KEY BOX.** A secure, tamperproof device with a lock operable only by a Civil Defence master key, and containing building entry keys and other keys that may be required for access in an emergency.

### SECTION 5C.3 FIRE APPARATUS ACCESS ROADS

- 5C.3.1 Where required.** Fire apparatus access roads shall be provided and maintained in accordance with Sections 5C.3.1.1 through 5C.3.1.3.
- 5C.3.1.1 Buildings and facilities.** Approved fire apparatus access roads shall be provided for every facility, building or portion of a building hereafter constructed or moved into or within the jurisdiction. The fire apparatus access road shall comply with the requirements of this section and shall extend to within 45.7 m of all portions of the facility and all portions of the exterior walls of the first story of the building as measured by an approved route around the exterior of the building or facility.  
**Exception:** The building official is authorized to increase the dimension of 45.7 m where:
1. The building is equipped throughout with an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1, 7.3.3.1.2 or 7.3.3.1.3.
  2. Fire apparatus access roads cannot be installed because of location on property, topography, water ways, nonnegotiable grades or other similar conditions, and an approved alternative means of fire protection is provided.
  3. There are not more than two Group R-3 or Group U occupancies.
- 5C.3.1.2 Additional access.** The building official is authorized to require more than one fire apparatus access road based on the potential for impairment of a single road by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access.
- 5C.3.1.3 High-piled storage.** Civil Defence vehicle access to buildings used for high-piled combustible storage shall comply with the applicable provisions of Chapter 21.
- 5C.3.2 Specifications.** Fire apparatus access roads shall be installed and arranged in accordance with Sections 5C.3.2.1 through 5C.3.2.7.
- 5C.3.2.1 Dimensions.** Fire apparatus access roads shall have an unobstructed width of not less than 6.1 m, except for approved security gates in accordance with Section 5C.3.6, and an unobstructed vertical clearance of not less than 4.1 m.
- 5C.3.2.2 Authority.** The building official shall have the authority to require an increase in the minimum access widths where they are inadequate for fire or rescue operations.
- 5C.3.2.3 Surface.** Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be surfaced so as to provide all-weather driving capabilities.
- 5C.3.2.4 Turning radius.** The required turning radius of a fire apparatus access road shall be determined by the building official.
- 5C.3.2.5 Dead ends.** Dead-end fire apparatus access roads in excess of 45.7 m in length shall be provided with an approved area for turning around fire apparatus.
- 5C.3.2.6 Bridges and elevated surfaces.** Where a bridge or an elevated surface is part of a fire apparatus access road, the bridge shall be constructed and maintained in accordance with MOT standards or (*AASHTO Standard Specification for Highway Bridges*). Bridges and elevated surfaces shall be designed for a live load sufficient to carry the imposed loads of fire apparatus. Vehicle load limits shall be posted at both entrances to bridges when required by the building official. Where elevated surfaces designed for emergency vehicle use are adjacent to surfaces which are not designed for such use, approved barriers, approved signs or both shall be installed and maintained when required by the building official.
- 5C.3.2.7 Grade.** The grade of the fire apparatus access road shall be within the limits established by the building official based on the Civil Defence's apparatus.



- 5C.3.3 Marking.** Where required by the building official, approved signs or other approved notices shall be provided for fire apparatus access roads to identify such roads or prohibit the obstruction thereof. Signs or notices shall be maintained in a clean and legible condition at all times and be replaced or repaired when necessary to provide adequate visibility.
- 5C.3.4 Obstruction of fire apparatus access roads.** Fire apparatus access roads shall not be obstructed in any manner, including the parking of vehicles. The minimum widths and clearances established in Section 5C.3.2.1 shall be maintained at all times.
- 5C.3.5 Required gates or barricades.** The building official is authorized to require the installation and maintenance of gates or other approved barricades across fire apparatus access roads, trails or other accessways, not including public streets, alleys or highways.
- 5C.3.5.1 Secured gates and barricades.** When required, gates and barricades shall be secured in an approved manner. Roads, trails and other accessways that have been closed and obstructed in the manner prescribed by Section 5C.3.5 shall not be trespassed on or used unless authorized by the owner and the building official.  
**Exception:** The restriction on use shall not apply to public officers acting within the scope of duty.
- 5C.3.6 Security gates.** The installation of security gates across a fire apparatus access road shall be approved by the fire chief. Where security gates are installed, they shall have an approved means of emergency operation. The security gates and the emergency operation shall be maintained operational at all times.

## SECTION 5C.4

### ACCESS TO BUILDING OPENINGS AND ROOFS

- 5C.4.1 Required access.** Exterior doors and openings required by these code requirements or the SBC 201 shall be maintained readily accessible for emergency access by the Civil Defence. An approved access walkway leading from fire apparatus access roads to exterior openings shall be provided when required by the building official.
- 5C.4.2 Maintenance of exterior doors and openings.** Exterior doors and their function shall not be eliminated without prior approval. Exterior doors that have been rendered nonfunctional and that retain a functional door exterior appearance shall have a sign affixed to the exterior side of the door with the words THIS DOOR BLOCKED. The sign shall consist of letters having a principal stroke of not less than 19.1 mm wide and at least 150 mm high on a contrasting background. Required Civil Defence access doors shall not be obstructed or eliminated. Exit and exit access doors shall comply with Chapter 8. Access doors for high-piled combustible storage shall comply with Section 21.6.6.1.
- 5C.4.3 Stairway access to roof.** New buildings four or more stories in height, except those with a roof slope greater than four units vertical in 12 units horizontal (33.3 percent slope), shall be provided with a stairway to the roof. Stairway access to the roof shall be in accordance with Section 8.9.12. Such stairway shall be marked at street and floor levels with a sign indicating that the stairway continues to the roof.

Where roofs are used for roof gardens or for other purposes, stairways shall be provided as required for such occupancy classification.

## SECTION 5C.5 PREMISES IDENTIFICATION

- 5C.5.1 Address numbers.** New and existing buildings shall have approved address numbers, building numbers or approved building identification placed in a position that is plainly legible and visible from the street or road fronting the property. These numbers shall contrast with their background. Address numbers shall be Arabic numerals or alphabet letters. Numbers shall be a minimum of 100 mm high with a minimum stroke width of 12.7 mm.
- 5C.5.2 Street or road signs.** Streets and roads shall be identified with approved signs. Temporary signs shall be installed at each street intersection when construction of new roadways allows passage by vehicles. Signs shall be of an approved size, weather resistant and be maintained until replaced by permanent signs.

## SECTION 5C.6 KEY BOXES

- 5C.6.1 Where required.** Where access to or within a structure or an area is restricted because of secured openings or where immediate access is necessary for life-saving or fire-fighting purposes, the building official is authorized to require a key box to be installed in an approved location. The key box shall be of an approved type and shall contain keys to gain necessary access as required by the building official.
- 5C.6.1.1 Locks.** An approved lock shall be installed on gates or similar barriers when required by the building official.
- 5C.6.2 Key box maintenance.** The operator of the building shall immediately notify the building official and provide the new key when a lock is changed or rekeyed. The key to such lock shall be secured in the key box.

## SECTION 5C.7 HAZARDS TO FIRE FIGHTERS

- 5C.7.1 Trapdoors to be closed.** Trapdoors and scuttle covers, other than those that are within a dwelling unit or automatically operated, shall be kept closed at all times except when in use.
- 5C.7.2 Shaftway markings.** Vertical shafts shall be identified as required by this section.
- 5C.7.2.1 Exterior access to shaftways.** Outside openings accessible to the Civil Defence and which open directly on a hoistway or shaftway communicating between two or more floors in a building shall be plainly marked with the word SHAFTWAY in red letters at least 150 mm high on a white background. Such warning signs shall be placed so as to be readily discernible from the outside of the building.
- 5C.7.2.2 Interior access to shaftways.** Door or window openings to a hoistway or shaftway from the interior of the building shall be plainly marked with the word SHAFTWAY in red letters at least 150 mm high on a white background. Such warning signs shall be placed so as to be readily discernible.
- Exception:** Marking shall not be required on shaftway openings which are readily

discernible as openings onto a shaftway by the construction or arrangement.

- 5C.7.3 Pitfalls.** The intentional design or alteration of buildings to disable, injure, maim or kill intruders is prohibited. No person shall install and use firearms, sharp or pointed objects, razor wire, explosives, flammable or combustible liquid containers, or dispensers containing highly toxic, toxic, irritant or other hazardous materials in a manner which may passively or actively disable, injure, maim or kill a fire fighter who forcibly enters a building for the purpose of controlling or extinguishing a fire, rescuing trapped occupants or rendering other emergency assistance.

## **SECTION 5C.8 FIRE PROTECTION WATER SUPPLIES**

- 5C.8.1 Required water supply.** An approved water supply capable of supplying the required fire flow for fire protection shall be provided to premises upon which facilities, buildings or portions of buildings are hereafter constructed or moved into or within the jurisdiction.
- 5C.8.2 Type of water supply.** A water supply shall consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.
- 5C.8.2.1 Private fire service mains.** Private fire service mains and appurtenances shall be installed in accordance with NFPA 24.
- 5C.8.2.2 Water tanks.** Water tanks for private fire protection shall be installed in accordance with NFPA 22.
- 5C.8.3 Fire flow.** Fire flow requirements for buildings or portions of buildings and facilities shall be determined by an approved method.
- 5C.8.4 Water supply test.** The building official shall be notified prior to the water supply test. Water supply tests shall be witnessed by the building official or approved documentation of the test shall be provided to the building official prior to final approval of the water supply system.
- 5C.8.5 Fire hydrant systems.** Fire hydrant systems shall comply with Sections 5C.8.5.1 through 5C.8.5.6.
- 5C.8.5.1 Where required.** Where a portion of the facility or building hereafter constructed or moved into or within the jurisdiction is more than 122 m from a hydrant on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building, on-site fire hydrants and mains shall be provided where required by the building official.
- Exceptions:**
1. For Group R-3 and Group U occupancies, the distance requirement shall be 183 m.
  2. For buildings equipped throughout with an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, the distance requirement shall be 183 m.
- 5C.8.5.2 Inspection, testing and maintenance.** Fire hydrant systems shall be subject to periodic tests as required by the building official. Fire hydrant systems shall be maintained in an operative condition at all times and shall be repaired where defective. Additions, repairs, alterations and servicing shall comply with approved

standards.

**5C.8.5.3 Private fire service mains and water tanks.** Private fire service mains and water tanks shall be periodically inspected, tested and maintained in accordance with NFPA 25 at the following intervals:

1. Private fire hydrants (all types): Inspection annually and after each operation; flow test and maintenance annually.
2. Fire service main piping: Inspection of exposed, annually; flow test every 5 years.
3. Fire service main piping strainers: Inspection and maintenance after each use.

**5C.8.5.4 Obstruction.** Posts, fences, vehicles, growth, trash, storage and other materials or objects shall not be placed or kept near fire hydrants, Civil Defence inlet connections or fire protection system control valves in a manner that would prevent such equipment or fire hydrants from being immediately discernible. The Civil Defence shall not be deterred or hindered from gaining immediate access to fire protection equipment or fire hydrants.

**5C.8.5.5 Clear space around hydrants.** A 900 mm clear space shall be maintained around the circumference of fire hydrants except as otherwise required or approved.

**5C.8.5.6 Physical protection.** Where fire hydrants are subject to impact by a motor vehicle, guard posts or other approved means shall comply with Section 5A.12.

## SECTION 5C.9 FIRE COMMAND CENTER

**5C.9.1 Features.** Where required by other sections of these code requirements and in all buildings classified as high-rise buildings by the SBC, a fire command center for Civil Defence operations shall be provided. The location and accessibility of the fire command center shall be approved by the Civil Defence. The fire command center shall be separated from the remainder of the building by not less than a 1-hour fire-resistance-rated fire barrier. The room shall be a minimum of 9 m<sup>2</sup> with a minimum dimension of 2.4 m. A layout of the fire command center and all features required by this section to be contained therein shall be submitted for approval prior to installation. The fire command center shall comply with NFPA 72 and shall contain the following features:

1. The emergency voice/alarm communication system unit.
2. The Civil Defence communications system.
3. Fire-detection and alarm system annunciator system.
4. Annunciator visually indicating the location of the elevators and whether they are operational.
5. Status indicators and controls for air-handling systems.
6. The fire-fighter's control panel required by Section 7.9.16 for smoke control systems installed in the building.
7. Controls for unlocking stairway doors simultaneously.
8. Sprinkler valve and water-flow detector display panels.
9. Emergency and standby power status indicators.
10. A telephone for Civil Defence use with controlled access to the public telephone system.
11. Fire pump status indicators.
12. Schematic building plans indicating the typical floor plan and detailing the building core, means of egress, fire protection systems, fire-fighting equipment and Civil Defence access.
13. Work table.

14. Generator supervision devices, manual start and transfer features.
15. Public address system, where specifically required by other sections of these code requirements.

## SECTION 5C.10 CIVIL DEFENCE ACCESS TO EQUIPMENT

- 5C.10.1 Identification.** Fire protection equipment shall be identified in an approved manner. Rooms containing controls for air-conditioning systems, sprinkler risers and valves, or other fire detection, suppression or control elements shall be identified for the use of the Civil Defence. Approved signs required to identify fire protection equipment and equipment location, shall be constructed of durable materials, permanently installed and readily visible.

## SECTION 5D BUILDING SERVICES AND SYSTEMS

### SECTION 5D.1 GENERAL

- 5D.1.1 Scope.** The provisions of this section shall apply to the installation, operation and maintenance of fuel-fired appliances and heating systems, emergency and standby power systems, electrical systems and equipment, mechanical refrigeration systems, elevator recall, stationary lead-acid battery systems and commercial kitchen hoods.
- 5D.1.2 Permits.** Permits shall be obtained for refrigeration systems and battery systems as set forth in SBC 100.

### SECTION 5D.2 DEFINITIONS

- 5D.2.1 Definitions.** The following words and terms shall, for the purposes of this section and as used elsewhere in these code requirements, have the meanings shown herein.

**BATTERY, LEAD ACID.** A group of electrochemical cells interconnected to supply a nominal voltage of DC power to a suitably connected electrical load. The number of cells connected in series determines the nominal voltage rating of the battery. The size of the cells determines the discharge capacity of the entire battery.

**BATTERY SYSTEM, STATIONARY LEAD ACID.** A system which consists of three interconnected subsystems:

1. A lead-acid battery.
2. A battery charger.
3. A collection of rectifiers, inverters, converters, and associated electrical equipment as required for a particular application.

**COMMERCIAL COOKING APPLIANCES.** Appliances used in a commercial food service establishment for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a

local exhaust ventilation system. Such appliances include deep fat fryers; upright broilers; griddles; broilers; steam-jacketed kettles; hot-top ranges; under-fired broilers (charbroilers); ovens; barbecues; rotisseries; and similar appliances. For the purpose of this definition, a food service establishment shall include any building or a portion thereof used for the preparation and serving of food.

**HOOD.** An air-intake device used to capture by entrapment, impingement, adhesion or similar means, grease and similar contaminants before they enter a duct system.

**Type I.** A kitchen hood for collecting and removing grease vapors and smoke.

**REFRIGERANT.** The fluid used for heat transfer in a refrigerating system; the refrigerant absorbs heat and transfers it at a higher temperature and a higher pressure, usually with a change of state.

**REFRIGERATION SYSTEM.** A combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat.

**VALVE-REGULATED LEAD-ACID (VRLA) BATTERY.** A lead-acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount. In VRLA batteries, the liquid electrolyte in the cells is immobilized in an absorptive glass mat (AGM cells or batteries) or by the addition of a gelling agent (gel cells or gelled batteries).

**VENTED (FLOODED) LEAD-ACID BATTERY.** A lead-acid battery consisting of cells that have electrodes immersed in liquid electrolyte. Flooded lead-acid batteries have a provision for the user to add water to the cell and are equipped with a flame-arresting vent which permits the escape of hydrogen and oxygen gas from the cell in a diffused manner such that a spark, or other ignition source, outside the cell will not ignite the gases inside the cell.

### SECTION 5D.3 FUEL-FIRED APPLIANCES

- 5D.3.1     Installation.** The installation of nonportable fuel gas appliances and systems shall be carried out by an approved method. The installation of all other fuel-fired appliances, other than internal combustion engines, oil lamps and portable devices such as blow torches, melting pots and weed burners, shall comply with this section and the SBC 501.
- 5D.3.1.1   Manufacturer's instructions.** The installation shall be made in accordance with the manufacturer's instructions and applicable local rules and regulations. Where it becomes necessary to change, modify, or alter a manufacturer's instructions in any way, written approval shall first be obtained from the manufacturer.
- 5D.3.1.2   Approval.** The design, construction and installation of fuel-fired appliances shall be in accordance with the SBC 100 and the SBC 501.
- 5D.3.1.3   Electrical wiring and equipment.** Electrical wiring and equipment used in connection with oil-burning equipment shall be installed and maintained in accordance with Section 5D.5 and the SBC 401.
- 5D.3.1.4   Fuel oil.** The grade of fuel oil used in a burner shall be that for which the burner is approved and as stipulated by the burner manufacturer. Oil containing gasoline

shall not be used. Waste crankcase oil shall be an acceptable fuel in Group F, M and S occupancies, when utilized in equipment listed for use with waste oil and when such equipment is installed in accordance with the manufacturer's instructions and the terms of its listing.

- 5D.3.1.5 Access.** The installation shall be readily accessible for cleaning hot surfaces; removing burners; replacing motors, controls, air filters, chimney connectors, draft regulators, and other working parts; and for adjusting, cleaning and lubricating parts.
- 5D.3.1.6 Testing, diagrams and instructions.** After installation of the oil-burning equipment, operation and combustion performance tests shall be conducted to determine that the burner is in proper operating condition and that all accessory equipment, controls, and safety devices function properly.
- 5D.3.1.6.1 Diagrams.** Contractors installing industrial oil-burning systems shall furnish not less than two copies of diagrams showing the main oil lines and controlling valves, one copy of which shall be posted at the oil-burning equipment and another at an approved location that will be accessible in case of emergency.
- 5D.3.1.6.2 Instructions.** After completing the installation, the installer shall instruct the owner or operator in the proper operation of the equipment. The installer shall also furnish the owner or operator with the name and telephone number of persons to contact for technical information or assistance and routine or emergency services.
- 5D.3.1.7 Clearances.** Working clearances between oil-fired appliances and electrical panelboards and equipment shall be in accordance with the SBC 401. Clearances between oil-fired equipment and oil supply tanks shall be in accordance with NFPA 31.
- 5D.3.2 Chimneys.** Masonry chimneys shall be constructed in accordance with the SBC 305. Factory-built chimneys shall be installed in accordance with the SBC 501. Metal chimneys shall be constructed and installed in accordance with NFPA 211.
- 5D.3.3 Fuel oil storage systems.** Fuel oil storage systems shall be installed in accordance with these code requirements. Fuel oil piping systems shall be installed in accordance with the SBC 501.
- 5D.3.3.1 Maximum outside fuel oil storage above ground.** Where connected to a fuel-oil piping system, the maximum amount of fuel oil storage allowed outside above ground without additional protection shall be 2,500 L. The storage of fuel oil above ground in quantities exceeding 2,500 L shall comply with NFPA 31.
- 5D.3.3.2 Maximum inside fuel oil storage.** Where connected to a fuel-oil piping system, the maximum amount of fuel oil storage allowed inside any building shall be 2,500 L. Where the amount of fuel oil stored inside a building exceeds 2,500 L, the storage area shall be in compliance with the SBC 201.
- 5D.3.3.3 Underground storage of fuel oil.** The storage of fuel oil in underground storage tanks shall comply with NFPA 31.
- 5D.3.4 Portable unvented heaters.** Portable unvented fuel-fired heating equipment shall be prohibited in occupancies in Groups A, E, I, R-1, R-2, R-3 and R-4.  
**Exception:** Listed and approved unvented fuel-fired heaters in one- and two-family dwellings.
- 5D.3.4.1 Prohibited locations.** Unvented fuel-fired heating equipment shall not be located in, or obtain combustion air from, any of the following rooms or spaces: sleeping rooms, bathrooms, toilet rooms or storage closets.
- 5D.3.5 Heating appliances.** Heating appliances shall be listed and shall comply with this

section.

- 5D.3.5.1 Guard against contact.** The heating element or combustion chamber shall be permanently guarded so as to prevent accidental contact by persons or material.
- 5D.3.5.2 Heating appliance installation.** Heating appliances shall be installed in accordance with the manufacturer's instructions, the SBC 401, and the SBC 501.
- 5D.3.6 Chimneys and appliances.** Chimneys, incinerators, smokestacks or similar devices for conveying smoke or hot gases to the outer air and the stoves, furnaces, fireboxes or boilers to which such devices are connected, shall be maintained so as not to create a fire hazard.
- 5D.3.6.1 Masonry chimneys.** Masonry chimneys that, upon inspection, are found to be without a flue liner and that have open mortar joints which will permit smoke or gases to be discharged into the building, or which are cracked as to be dangerous, shall be repaired or relined with a listed chimney liner system installed in accordance with the manufacturer's installation instructions or a flue lining system installed in accordance with the SBC requirements and appropriate for the intended class of chimney service.
- 5D.3.6.2 Metal chimneys.** Metal chimneys which are corroded or improperly supported shall be repaired or replaced.
- 5D.3.6.3 Decorative shrouds.** Decorative shrouds installed at the termination of factory-built chimneys shall be removed except where such shrouds are listed and labeled for use with the specific factory-built chimney system and are installed in accordance with the chimney manufacturer's installation instructions.
- 5D.3.6.4 Factory-built chimneys.** Existing factory-built chimneys that are damaged, corroded or improperly supported shall be repaired or replaced.
- 5D.3.6.5 Connectors.** Existing chimney and vent connectors that are damaged, corroded or improperly supported shall be repaired or replaced.
- 5D.3.7 Discontinuing operation of unsafe heating appliances.** The building official is authorized to order that measures be taken to prevent the operation of any existing stove, oven, furnace, incinerator, boiler or any other heat-producing device or appliance found to be defective or in violation of code requirements for existing appliances after giving notice to this effect to any person, owner, firm or agent or operator in charge of the same. The building official is authorized to take measures to prevent the operation of any device or appliance without notice when inspection shows the existence of an immediate fire hazard or when imperiling human life. The defective device shall remain withdrawn from service until all necessary repairs or alterations have been made.
- 5D.3.7.1 Unauthorized operation.** It shall be a violation of these code requirements for any person, user, firm or agent to continue the utilization of any device or appliance (the operation of which has been discontinued or ordered discontinued in accordance with Section 5D.3.7), unless written authority to resume operation is given by the building official. Removing or breaking the means by which operation of the device is prevented shall be a violation of these code requirements.
- 5D.3.8 Incinerators.** Commercial, industrial and residential-type incinerators and chimneys shall be constructed in accordance with the SBC 501.
- 5D.3.8.1 Residential incinerators.** Residential incinerators shall be of an approved type.
- 5D.3.8.2 Spark arrestor.** Incinerators shall be equipped with an effective means for arresting sparks.
- 5D.3.8.3 Restrictions.** Where the building official determines that burning in incinerators



located within 152 m of mountainous, brush or grass-covered areas will create an undue fire hazard because of atmospheric conditions, such burning shall be prohibited.

**5D.3.8.4 Time of burning.** Burning shall take place only during approved hours.

**5D.3.8.5 Discontinuance.** The building official is authorized to require incinerator use to be discontinued immediately if the building official determines that smoke emissions are offensive to occupants of surrounding property or if the use of incinerators is determined by the building official to constitute a hazardous condition.

**5D.3.9 Gas meters.** Above-ground gas meters, regulators and piping subject to damage shall be protected by a barrier complying with Section 5A.12 or otherwise protected in an approved manner.

## SECTION 5D.4 EMERGENCY AND STANDBY POWER SYSTEMS

**5D.4.1 Installation.** Emergency and standby power systems shall be installed in accordance with the SBC 401, NFPA 110 and NFPA 111. Existing installations shall be maintained in accordance with the original approval.

**5D.4.1.1 Stationary generators.** Stationary emergency and standby power generators required by these code requirements shall be listed in accordance with UL 2200.

**5D.4.2 Where required.** Emergency and standby power systems shall be provided where required by Sections 5D.4.2.1 through 5D.4.2.18.

**5D.4.2.1 Group A occupancies.** Emergency power shall be provided for emergency voice/alarm communication systems in Group A occupancies in accordance with Section 7.7.2.1.2.

**5D.4.2.2 Smoke control systems.** Standby power shall be provided for smoke control systems in accordance with Section 7.9.11.

**5D.4.2.3 Exit signs.** Emergency power shall be provided for exit signs in accordance with Section 8.11.5.3.

**5D.4.2.4 Means of egress illumination.** Emergency power shall be provided for means of egress illumination in accordance with Section 8.6.3.

**5D.4.2.5 Accessible means of egress elevators or platform lifts.** Standby power shall be provided for elevators or platform lifts that are part of an accessible means of egress in accordance with Section 8.7.4 or 8.7.5, respectively.

**5D.4.2.6 Horizontal sliding doors.** Standby power shall be provided for horizontal sliding doors in accordance with Section 8.8.1.3.3.

**5D.4.2.7 Semiconductor fabrication facilities.** Emergency power shall be provided for semiconductor fabrication facilities in accordance with Section 16.3.15.

**5D.4.2.8 Membrane structures.** Emergency power shall be provided for exit signs in temporary tents and membrane structures in accordance with Section 22.3.12.6.1. Standby power shall be provided for auxiliary inflation systems in permanent membrane structures in accordance with the SBC requirements.

**5D.4.2.9 Hazardous materials.** Emergency or standby power shall be provided in occupancies with hazardous materials in accordance with Sections 25.4.7 and 25.5.1.5.

**5D.4.2.10 Highly toxic and toxic materials.** Emergency power shall be provided for occupancies with highly toxic or toxic materials in accordance with Sections 35.4.2.2.8 and 35.4.3.2.6.

**5D.4.2.11 Organic peroxides.** Standby power shall be provided for occupancies with organic peroxides in accordance with Section 37.4.1.11.

- 5D.4.2.12 Pyrophoric materials.** Emergency power shall be provided for occupancies with silane gas in accordance with Sections 39.6.2.3 and 39.6.4.3.
- 5D.4.2.13 Covered mall buildings.** Covered mall buildings exceeding 4,645 m<sup>2</sup> shall be provided with standby power systems which are capable of operating the emergency voice/alarm communication.
- 5D.4.2.14 High-rise buildings.** Standby power, light and emergency systems in high-rise buildings shall comply with the requirements of Sections 5D.4.2.14.1 through 5D.4.2.14.3.
- 5D.4.2.14.1 Standby power.** A standby power system shall be provided. Where the standby system is a generator set inside a building, the system shall be located in a separate room enclosed with 2-hour fire-resistance-rated fire barrier assemblies. System supervision with manual start and transfer features shall be provided at the fire command center.
- 5D.4.2.14.1.1 Fuel supply.** An on-premises fuel supply, sufficient for not less than 2-hour full-demand operation of the system, shall be provided.  
**Exception:** Where the system is supplied with pipeline natural gas and is approved.
- 5D.4.2.14.1.2 Capacity.** The standby system shall have a capacity and rating that supplies all equipment required to be operational at the same time. The generating capacity is not required to be sized to operate all of the connected electrical equipment simultaneously.
- 5D.4.2.14.1.3 Connected facilities.** Power and lighting facilities for the fire command center and elevators specified in Sections 5B.3.8 and 5B.3.9, as applicable, and electrically powered fire pumps required to maintain pressure, shall be transferable to the standby source. Standby power shall be provided for at least one elevator to serve all floors and be transferable to any elevator.
- 5D.4.2.14.2 Separate circuits and fixtures.** Separate lighting circuits and fixtures shall be required to provide sufficient light with an intensity of not less than 11 lux measured at floor level in all means of egress corridors, stairways, smoke proof enclosures, elevator cars and lobbies, and other areas which are clearly a part of the escape route.
- 5D.4.2.14.2.1 Other circuits.** Circuits supplying lighting for the fire command center and mechanical equipment rooms shall be transferable to the standby source.
- 5D.4.2.14.3 Emergency systems.** Exit signs, exit illumination as required by Chapter 8, and elevator car lighting are classified as emergency systems and shall operate within 10 seconds of failure of the normal power supply and shall be capable of being transferred to the standby source.  
**Exception:** Exit sign, exit and means of egress illumination are permitted to be powered by a standby source in buildings of Group F and S occupancies.
- 5D.4.2.15 Underground buildings.** Emergency and standby power systems in underground buildings covered in Chapter 2 of SBC 201 shall comply with Sections 5D.4.2.15.1 and 5D.4.2.15.2.
- 5D.4.2.15.1 Standby power.** A standby power system complying with the SBC 401 shall be provided for standby power loads as specified in Section 5D.4.2.15.1.1.
- 5D.4.2.15.1.1 Standby power loads.** The following loads are classified as standby power loads:
1. Smoke control system.
  2. Ventilation and automatic fire detection equipment for smokeproof enclosures.
  3. Fire pumps.
  4. Standby power shall be provided for elevators in accordance with the SBC 401 and 501.
- 5D.4.2.15.1.2 Pickup time.** The standby power system shall pick up its connected loads within 60 seconds of failure of the normal power supply.

**5D.4.2.15.2 Emergency power.** An emergency power system complying with the SBC 401 shall be provided for emergency power loads as specified in Section 5D.4.2.15.2.1.

**5D.4.2.15.2.1 Emergency power loads.** The following loads are classified as emergency power loads:

1. Emergency voice/alarm communication systems.
2. Fire alarm systems.
3. Automatic fire detection systems.
4. Elevator car lighting.
5. Means of egress lighting and exit sign illumination as required by Chapter 8.

**5D.4.2.16 Group I-3 occupancies.** Power-operated sliding doors or power-operated locks for swinging doors in Group I-3 occupancies shall be operable by a manual release mechanism at the door, and either emergency power or a remote mechanical operating release shall be provided.

**Exception:** Emergency power is not required in facilities where provisions for remote locking and unlocking of occupied rooms in Occupancy Condition 4 are not required as set forth in the SBC.

**5D.4.2.17 Airport traffic control towers.** A standby power system shall be provided in airport traffic control towers more than 19.8 m in height. Power shall be provided to the following equipment:

1. Pressurization equipment, mechanical equipment and lighting.
2. Elevator operating equipment.
3. Fire alarm and smoke detection systems.

**5D.4.2.18 Elevators.** In buildings and structures where standby power is required or furnished to operate an elevator, the operation shall be in accordance with Sections 5D.4.2.18.1 through 5D.4.2.18.4.

**5D.4.2.18.1 Manual transfer.** Standby power shall be manually transferable to all elevators in each bank.

**5D.4.2.18.2 One elevator.** Where only one elevator is installed, the elevator shall automatically transfer to standby power within 60 seconds after failure of normal power.

**5D.4.2.18.3 Two or more elevators.** Where two or more elevators are controlled by a common operating system, all elevators shall automatically transfer to standby power within 60 seconds after failure of normal power where the standby power source is of sufficient capacity to operate all elevators at the same time. Where the standby power source is not of sufficient capacity to operate all elevators at the same time, all elevators shall transfer to standby power in sequence, return to the designated landing and disconnect from the standby power source. After all elevators have been returned to the designated level, at least one elevator shall remain operable from the standby power source.

**5D.4.2.18.4 Venting.** Where standby power is connected to elevators, the machine room ventilation or air conditioning shall be connected to the standby power source.

**5D.4.3 Maintenance.** Emergency and standby power systems shall be maintained such that the system is capable of supplying service within the time specified for the type and duration required.

**5D.4.3.1 Schedule.** Inspection, testing and maintenance of emergency and standby power systems shall be in accordance with an approved schedule established upon completion and approval of the system installation.

**5D.4.3.2 Written record.** Written records of the inspection, testing and maintenance of emergency and standby power systems shall include the date of service, name of the servicing technician, a summary of conditions noted and a detailed description of any conditions requiring correction and what corrective action was taken. Such

records shall be kept on the premises served by the emergency or standby power system and be available for inspection by the building official.

**5D.4.3.3 Switch maintenance.** Emergency and standby power system transfer switches shall be included in the inspection, testing and maintenance schedule required by Section 5D.4.3.1. Transfer switches shall be maintained free from accumulated dust and dirt. Inspection shall include examination of the transfer switch contacts for evidence of deterioration. When evidence of contact deterioration is detected, the contacts shall be replaced in accordance with the transfer switch manufacturer's instructions.

**5D.4.4 Operational inspection and testing.** Emergency power systems, including all appurtenant components shall be inspected and tested under load in accordance with NFPA 110 and NFPA 111.

**Exception:** Where the emergency power system is used for standby power or peak load shaving, such use shall be recorded and shall be allowed to be substituted for scheduled testing of the generator set, provided that appropriate records are maintained.

**5D.4.4.1 Transfer switch test.** The test of the transfer switch shall consist of electrically operating the transfer switch from the normal position to the alternate position and then return to the normal position.

**5D.4.5 Supervision of maintenance and testing.** Routine maintenance, inspection and operational testing shall be overseen by a properly instructed individual.

## SECTION 5D.5 ELECTRICAL EQUIPMENT, WIRING AND HAZARDS

**5D.5.1 Abatement of electrical hazards.** Identified electrical hazards shall be abated. Identified hazardous electrical conditions in permanent wiring shall be brought to the attention of the code official responsible for enforcement of the SBC 401. Electrical wiring, devices, appliances and other equipment that is modified or damaged and constitutes an electrical shock or fire hazard shall not be used.

**5D.5.2 Illumination.** Illumination shall be provided for service equipment areas, motor control centers and electrical panelboards.

**5D.5.3 Working space and clearance.** A working space of not less than 760 mm in width, 900 mm in depth and 2 m in height shall be provided in front of electrical service equipment. Where the electrical service equipment is wider than 760 mm, the working space shall not be less than the width of the equipment. No storage of any materials shall be located within the designated working space.

**Exceptions:**

1. Where other dimensions are required or allowed by the SBC 401.
2. Access openings into attics or under-floor areas which provide a minimum clear opening of 560 mm by 760 mm.

**5D.5.3.1 Labeling.** Doors into electrical control panel rooms shall be marked with a plainly visible and legible sign stating ELECTRICAL ROOM or similar approved wording. The disconnecting means for each service, feeder or branch circuit originating on a switchboard or panelboard shall be legibly and durably marked to indicate its purpose unless such purpose is clearly evident.

**5D.5.4 Multiplug adapters.** Multiplug adaptors, such as cube adaptors, unfused plug

strips or any other device not complying with the SBC 401 shall be prohibited.

- 5D.5.4.1 Power tap design.** Relocatable power taps shall be of the polarized or grounded type, equipped with overcurrent protection, and shall be listed.
- 5D.5.4.2 Power supply.** Relocatable power taps shall be directly connected to a permanently installed receptacle.
- 5D.5.4.3 Installation.** Relocatable power tap cords shall not extend through walls, ceilings, floors, under doors or floor coverings, or be subject to environmental or physical damage.
- 5D.5.5 Extension cords.** Extension cords and flexible cords shall not be a substitute for permanent wiring. Extension cords and flexible cords shall not be affixed to structures, extended through walls, ceilings or floors, or under doors or floor coverings, nor shall such cords be subject to environmental damage or physical impact. Extension cords shall be used only with portable appliances.
- 5D.5.5.1 Power supply.** Extension cords shall be plugged directly into an approved receptacle, power tap or multiplug adapter and, except for approved multiplug extension cords, shall serve only one portable appliance.
- 5D.5.5.2 Ampacity.** The ampacity of the extension cords shall not be less than the rated capacity of the portable appliance supplied by the cord.
- 5D.5.5.3 Maintenance.** Extension cords shall be maintained in good condition without splices, deterioration or damage.
- 5D.5.5.4 Grounding.** Extension cords shall be grounded when serving grounded portable appliances.
- 5D.5.6 Unapproved conditions.** Open junction boxes and open-wiring splices shall be prohibited. Approved covers shall be provided for all switch and electrical outlet boxes.
- 5D.5.7 Appliances.** Electrical appliances and fixtures shall be tested and listed in published reports of inspected electrical equipment by an approved agency and installed in accordance with all instructions included as part of such listing.
- 5D.5.8 Electrical motors.** Electrical motors shall be maintained free from excessive accumulations of oil, dirt, waste and debris.
- 5D.5.9 Temporary wiring.** Temporary wiring for electrical power and lighting installations is allowed for a period not to exceed 90 days. Temporary wiring methods shall meet the applicable provisions of the SBC 401.  
**Exception:** Temporary wiring for electrical power and lighting installations is allowed during periods of construction, remodeling, repair or demolition of buildings, structures, equipment or similar activities.
- 5D.5.9.1 Attachment to structures.** Temporary wiring attached to a structure shall be attached in an approved manner.

## SECTION 5D.6 MECHANICAL REFRIGERATION

- 5D.6.1 Scope.** Refrigeration systems shall be installed in accordance with the SBC 501.
- 5D.6.2 Refrigerants.** The use and purity of new, recovered, and reclaimed refrigerants shall be in accordance with the SBC 501.

- 5D.6.3 Refrigerant classification.** Refrigerants shall be classified in accordance with the SBC 501.
- 5D.6.4 Change in refrigerant type.** A change in the type of refrigerant in a refrigeration system shall be in accordance with the SBC 501.
- 5D.6.5 Access.** Refrigeration systems having a refrigerant circuit containing more than 100 kg of Group A1 or 14 kg of any other group refrigerant shall be accessible to the Civil Defence at all times as required by the building official.
- 5D.6.6 Testing of equipment.** Refrigeration equipment and systems having a refrigerant circuit containing more than 100 kg of Group A1 or 14 kg of any other group refrigerant shall be subject to periodic testing in accordance with Section 5D.6.6.1. A written record of required testing shall be maintained on the premises. Tests of emergency devices or systems required by this section shall be conducted by persons trained and qualified in refrigeration systems.
- 5D.6.6.1 Periodic testing.** The following emergency devices or systems shall be periodically tested in accordance with the manufacturer's instructions and as required by the building official.
1. Treatment and flaring systems.
  2. Valves and appurtenances necessary to the operation of emergency refrigeration control boxes.
  3. Fans and associated equipment intended to operate emergency ventilation systems.
  4. Detection and alarm systems.
- 5D.6.7 Emergency signs.** Refrigeration units or systems having a refrigerant circuit containing more than 100 kg of Group A1 or 14 kg of any other group refrigerant shall be provided with approved emergency signs, charts, and labels in accordance with NFPA 704. Hazard signs shall be in accordance with the SBC 501 for the classification of refrigerants listed therein.
- 5D.6.8 Refrigerant detector.** Machinery rooms shall contain a refrigerant detector with an audible and visual alarm. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The alarm shall be actuated at a value not greater than the corresponding TLV-TWA values shown in the SBC 501 for the refrigerant classification. Detectors and alarms shall be placed in approved locations.  
**Exception:** Detectors are not required for ammonia systems where the machinery room complies with the SBC 501.
- 5D.6.9 Remote controls.** Remote control of the mechanical equipment and appliances located in the machinery room shall be provided at an approved location immediately outside the machinery room and adjacent to its principal entrance.
- 5D.6.9.1 Refrigeration system.** A clearly identified switch of the break-glass type shall provide off-only control of electrically energized equipment and appliances in the machinery room, other than refrigerant leak detectors and machinery room ventilation.
- 5D.6.9.2 Ventilation system.** A clearly identified switch of the break-glass type shall provide on-only control of the machinery room ventilation fans.
- 5D.6.9.3 Emergency control box.** Emergency control boxes shall be provided for refrigeration systems required to be equipped with a treatment system, flaring

system or ammonia diffusion system.

- 5D.6.9.3.1 Location.** Emergency control boxes shall be located outside of the building at an approved accessible location. All portions of the emergency control box shall be 1.8 m or less above the adjoining grade.
- 5D.6.9.3.2 Construction.** Emergency control boxes shall be of iron or steel not less than 1.4 mm in thickness and provided with a hinged cover and lock.
- 5D.6.9.3.3 Operational procedure.** Valves and switches shall be identified in an approved manner as to the sequential procedure to be followed in the event of an emergency.
- 5D.6.9.3.4 Identification.** Emergency control boxes shall be provided with a permanent label on the outside cover reading: CIVIL DEFENCE USE ONLY – REFRIGERANT CONTROL BOX, and including the name of the refrigerant in the system. Hazard identification in accordance with NFPA 704 shall be posted inside and outside of the control box.
- 5D.6.9.3.5 Instructions.** Written instructions and information shall be provided and located in the emergency control box designating the following information:
1. Instructions for suspending operation of the system in the event of an emergency.
  2. The name, address and emergency telephone numbers to obtain emergency service.
  3. The location and operation of emergency discharge systems.
- 5D.6.10 Storage, use and handling.** Flammable and combustible materials shall not be stored in machinery rooms for refrigeration systems having a refrigerant circuit containing more than 100 kg of Group A1 or 14 kg of any other group refrigerant. Storage, use or handling of extra refrigerant or refrigerant oils shall be as required by Chapters 25, 28, 30 and 32.
- Exception:** This provision shall not apply to spare parts, tools, and incidental materials necessary for the safe and proper operation and maintenance of the system.
- 5D.6.11 Termination of relief devices.** Pressure relief devices, fusible plugs and purge systems for refrigeration systems containing more than 3 kg of flammable, toxic or highly toxic refrigerants shall be provided with an approved discharge system as required by Sections 5D.6.11.1, 5D.6.11.2 and 5D.6.11.3. Discharge piping and devices connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging the pipe in the event of the fusible plug or rupture member functions.
- 5D.6.11.1 Flammable refrigerants.** Systems containing flammable refrigerants having a density equal to or greater than the density of air shall discharge vapor to the atmosphere only through an approved treatment system in accordance with Section 5D.6.11.4 or a flaring system in accordance with Section 5D.6.11.5. Systems containing flammable refrigerants having a density less than the density of air shall be permitted to discharge vapor to the atmosphere provided that the point of discharge is located outside of the structure at not less than 4.6 m above the adjoining grade level and not less than 6.1 m from any window, ventilation opening or exit.
- 5D.6.11.2 Toxic and highly toxic refrigerants.** Systems containing toxic or highly toxic refrigerants shall discharge vapor to the atmosphere only through an approved treatment system in accordance with Section 5D.6.11.4 or a flaring system in accordance with Section 5D.6.11.5.
- 5D.6.11.3 Ammonia refrigerant.** Systems containing ammonia refrigerant shall discharge vapor to the atmosphere through an approved treatment system in accordance with

Section 5D.6.11.4, a flaring system in accordance with Section 5D.6.11.5, or through an approved ammonia diffusion system in accordance with Section 5D.6.11.6, or by other approved means.

**Exceptions:**

1. Ammonia/water absorption systems containing less than 10 kg of ammonia and for which the ammonia circuit is located entirely outdoors.
2. When the building official determines, on review of an engineering analysis prepared in accordance with SBC 100, that a fire, health or environmental hazard would not result from discharging ammonia directly to the atmosphere.

**5D.6.11.4 Treatment systems.** Treatment systems shall be designed to reduce the allowable discharge concentration of the refrigerant gas to not more than 50 percent of the IDLH at the point of exhaust. Treatment systems shall be in accordance with Chapter 35.

**5D.6.11.5 Flaring systems.** Flaring systems for incineration of flammable refrigerants shall be designed to incinerate the entire discharge. The products of refrigerant incineration shall not pose health or environmental hazards. Incineration shall be automatic upon initiation of discharge, shall be designed to prevent blowback, and shall not expose structures or materials to threat of fire. Standby fuel, such as LP gas, and standby power shall have the capacity to operate for one and one-half the required time for complete incineration of refrigerant in the system.

**5D.6.11.6 Ammonia diffusion systems.** Ammonia diffusion systems shall include a tank containing 4 L of water for each 1 kg of ammonia that will be released in 1 hour from the largest relief device connected to the discharge pipe. The water shall be prevented from freezing. The discharge pipe from the pressure relief device shall distribute ammonia in the bottom of the tank, but no lower than 10.1 m below the maximum liquid level. The tank shall contain the volume of water and ammonia without overflowing.

**5D.6.12 Discharge location for refrigeration machinery room ventilation.** Exhaust from mechanical ventilation systems serving refrigeration machinery rooms capable of exceeding 25 percent of the LFL or 50 percent of the IDLH shall be equipped with approved treatment systems to reduce the discharge concentrations of flammable, toxic or highly toxic refrigerants to those values or lower.

**5D.6.13 Notification of refrigerant discharges.** The building official shall be notified immediately when a discharge becomes reportable under local regulations in accordance with Section 25.3.3.1.

**5D.6.14 Records.** A written record shall be kept of refrigerant quantities brought into and removed from the premises. Such records shall be available to the building official.

**5D.6.15 Electrical equipment.** Where refrigerants of Groups A2, A3, B2 and B3, as defined in the SBC 501, are used, refrigeration machinery rooms shall conform to the Class I, Division 2 hazardous location classification requirements of the SBC 401.

**Exception:** Ammonia machinery rooms that are provided with ventilation in accordance with SBC 501.



## SECTION 5D.7 ELEVATOR RECALL AND MAINTENANCE

- 5D.7.1 Required.** Existing elevators with a travel distance of 25 level of a building and intended to serve the needs of emergency personnel for fire-fighting or rescue purposes shall be provided with emergency operation in accordance with ASME A17.3. New elevators shall be provided with Phase I emergency recall operation and Phase II emergency in-car operation in accordance with ASME A17.1.
- 5D.7.2 Emergency signs.** An approved pictorial sign of a standardized design shall be posted adjacent to each elevator call station on all floors instructing occupants to use the exit stairways and not to use the elevators in case of fire. The sign shall read: IN FIRE EMERGENCY, DO NOT USE ELEVATOR. USE EXIT STAIRS. The emergency sign shall not be required for elevators that are part of an accessible means of egress complying with Section 8.7.4.
- 5D.7.3 Elevator keys.** Keys for the elevator car doors and fire-fighter service keys shall be kept in an approved location for immediate use by the Civil Defence.

## SECTION 5D.8 STATIONARY LEAD-ACID BATTERY SYSTEMS

- 5D.8.1 Scope.** Stationary lead-acid battery systems using vented (flooded) lead-acid batteries having an electrolyte capacity of more than 189 L used for facility standby power, emergency power, or uninterrupted power supplies shall comply with this section. Valve-regulated lead-acid batteries are not subject to the requirements of this section, but shall comply with Section 7.9.
- 5D.8.2 Safety venting.** Batteries shall be provided with safety venting caps.
- 5D.8.3 Room design and construction.** Enclosure of stationary lead-acid system rooms shall comply with the SBC 201. The battery systems are permitted to be in the same room with the equipment they support.
- 5D.8.4 Spill control and neutralization.** An approved method and materials for the control and neutralization of a spill of electrolyte shall be provided. The method and materials shall be capable of controlling and neutralizing a spill from the largest lead-acid battery to a pH between 7.0 and 9.0.
- 5D.8.5 Ventilation.** Ventilation shall be provided in accordance with the SBC 501 and the following:
1. The ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room; or
  2. Continuous ventilation shall be provided at a rate of not less than  $0.0051 \text{ m}^3/(\text{s} \cdot \text{m}^2)$  of floor area of the room.
- 5D.8.6 Signs.** Doors into rooms or buildings containing stationary lead-acid battery systems shall be provided with approved signs. The signs shall state that the room contains lead-acid battery systems, that the battery room contains energized electrical circuits, and that the battery electrolyte solutions are corrosive liquids.
- 5D.8.7 Seismic protection.** The battery systems shall be seismically braced in accordance with the SBC 201.

- 5D.8.8 Smoke detection.** An approved automatic smoke detection system shall be installed in battery rooms in accordance with Section 7.7.2.23.

## SECTION 5D.9

### VALVE-REGULATED LEAD-ACID (VRLA) BATTERY SYSTEMS

- 5D.9.1 Scope.** Valve-regulated lead-acid (VRLA) battery systems having an electrolyte capacity of more than 189 L used for facility standby power, emergency power or uninterrupted power supplies (UPS) shall comply with this section.
- 5D.9.2 Safety vents.** VRLA batteries shall be equipped with self-resealing flame-arresting safety vents.
- 5D.9.3 Thermal runaway.** VRLA battery systems shall be provided with a listed device or other approved method to preclude, detect and control thermal runaway.
- 5D.9.4 Room design and construction.** Enclosure of VRLA battery system rooms shall comply with the SBC 201. The battery systems are permitted to be in the same room with the equipment they support. When VRLA battery systems are installed in a separate equipment room accessible only to authorized personnel, they shall be allowed to be installed on an open rack for ease of maintenance. When a VRLA battery system is situated in an occupied work center, it shall be housed in a noncombustible cabinet or other enclosure to prevent access by unauthorized personnel.
- 5D.9.5 Neutralization.** An approved manual method and materials for the neutralization of a release of electrolyte shall be provided. The method and materials shall be capable of controlling and neutralizing a release of 3 percent of the capacity of the largest VRLA cell or block in the room to a pH between 7.0 and 9.0.
- 5D.9.6 Room ventilation.** Ventilation shall be provided to limit the maximum concentration of hydrogen to 1 percent of the total volume of the room during the worst-case event of simultaneous “boost” charging of all batteries in the room. Where calculations are not provided to substantiate the ventilation rate, continuous ventilation at a rate of not less than  $0.0051 \text{ m}^3/(\text{s} \cdot \text{m}^2)$  of floor area of the room shall be provided. The ventilation shall be either mechanically or naturally induced.
- 5D.9.7 Cabinet ventilation.** Where VRLA batteries are installed inside a cabinet, the cabinet shall be vented. The cabinet ventilation shall limit the maximum concentration of hydrogen to 1 percent of the total volume of the cabinet during the worst-case event of simultaneous “boost” charging of all batteries in the cabinet. Where calculations are not provided to substantiate the ventilation rate, continuous ventilation at a rate of not less than  $0.0051 \text{ m}^3/(\text{s} \cdot \text{m}^2)$  of floor area covered by the cabinet shall be provided. The ventilation shall be either mechanically or naturally induced. The room in which the cabinet is installed shall also be ventilated as required in Section 7.9.6.
- 5D.9.8 Signs.** Doors into electrical equipment rooms containing VRLA battery systems shall be provided with approved signs. The signs shall state that the room contains lead-acid battery systems and contains energized electrical circuits. Where VRLA

batteries are contained in cabinets in occupied work centers, the cabinet enclosures shall be located within 3 m of the equipment that they support. The cabinets shall have exterior labels that identify the manufacturer and model number of the system and electrical rating (voltage and current) of the contained battery system. Within the cabinet there shall be signs that indicate the relevant electrical, chemical and fire hazards.

- 5D.9.9 Seismic protection.** The battery systems shall be seismically braced in accordance with the SBC 301.
- 5D.9.10 Smoke detection.** An approved automatic smoke detection system shall be installed in rooms containing VRLA battery systems in accordance with Section 7.7.2.23.

## **SECTION 5D.10 COMMERCIAL KITCHEN HOODS**

- 5D.10.1 General.** Commercial kitchen exhaust hoods shall comply with the requirements of the SBC 501.
- 5D.10.2 Where required.** A Type I hood shall be installed at or above all commercial cooking appliances and domestic cooking appliances used for commercial purposes that produce grease vapors.



## **CHAPTER 6**

### **INTERIOR FINISH, DECORATIVE MATERIALS AND FURNISHINGS**

#### **SECTION 6.1**

##### **GENERAL**

- 6.1.1 Scope.** The provisions of this chapter shall govern furniture and furnishings, interior finishes, interior trim, decorative materials and decorative vegetation in buildings. Sections 6.3, 6.4 and 6.5 shall be applicable to new and existing buildings. Section 6.6 shall be applicable to existing buildings.

#### **SECTION 6.2**

##### **DEFINITIONS**

- 6.2.1 Terms defined in Chapter 1.** Words and terms used in this chapter and defined in Chapter 1 shall have the meanings ascribed to them as defined therein.

#### **SECTION 6.3**

##### **FURNISHINGS**

- 6.3.1 General requirements.** The provisions of Sections 6.3.1.1 through 6.3.1.3 shall be applicable to all occupancies covered by Sections 6.3.2 through 6.3.7.
- 6.3.1.1 Explosive and highly flammable materials.** Furnishings or decorations of an explosive or highly flammable character shall not be used.
- 6.3.1.2 Fire-retardant coatings.** Fire-retardant coatings shall be maintained so as to retain the effectiveness of the treatment under service conditions encountered in actual use.
- 6.3.1.3 Obstructions.** Furnishings or other objects shall not be placed to obstruct exits, access thereto, egress there from or visibility thereof.
- 6.3.2 Group A.** The requirements in Sections 6.3.2.1 and 6.3.2.2 shall apply to occupancies in Group A.
- 6.3.2.1 Foam plastics.** Exposed foam plastic materials and unprotected materials containing foam plastic used for decorative purposes or stage scenery or exhibit booths shall have a maximum heat release rate of 100 kilowatts (kW) when tested in accordance with UL 1975.
- Exceptions:**
1. Individual foam plastic items or items containing foam plastic where the foam plastic does not exceed 0.45 kg in weight.
  2. Cellular or foam plastic shall be allowed for trim not in excess of 10 percent of the wall or ceiling area, provided it is not less than 320 kg/m<sup>3</sup> in density, is limited to 12.7 mm in thickness and 100 mm in width, and complies with the requirements for Class B interior wall and ceiling finish, except that the smoke-developed index shall not be limited.
- 6.3.2.2 Motion picture screens.** The screens upon which motion pictures are projected shall be either flame resistant, as demonstrated by complying with NFPA 701, or shall comply with the requirements for a Class B interior finish.
- 6.3.3 Group E.** The requirements in Sections 6.3.3.1 and 6.3.3.2 shall apply to occupancies in Group E.

- 6.3.3.1 Storage in corridors and lobbies.** Clothing and personal effects shall not be stored in corridors and lobbies.  
**Exceptions:**
1. Corridors protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
  2. Corridors protected by an approved smoke detection system installed in accordance with Section 7.7.
  3. Storage in metal lockers provided the minimum required egress width is maintained.
- 6.3.3.2 Artwork.** Artwork and teaching materials shall be limited on the walls of corridors to not more than 20 percent of the wall area.
- 6.3.4 Group I-4, day care facilities.** The requirements in Sections 6.3.4.1 and 6.3.4.2 shall apply to day care facilities classified in Group I-4.
- 6.3.4.1 Storage in corridors and lobbies.** Clothing and personal effects shall not be stored in corridors and lobbies.  
**Exceptions:**
1. Corridors protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
  2. Corridors protected by an approved smoke detection system installed in accordance with Section 7.7.
  3. Storage in metal lockers provided the minimum required egress width is maintained.
- 6.3.4.2 Artwork.** Artwork and teaching materials shall be limited on walls of corridors to not more than 20 percent of the wall area.
- 6.3.5 Group I-2, nursing homes and hospitals.** The requirements in Sections 6.3.5.1 through 6.3.5.3 shall apply to nursing homes and hospitals classified in Group I-2.
- 6.3.5.1 Upholstered furniture.** Newly introduced upholstered furniture shall be shown to resist ignition by cigarettes as determined by tests conducted in accordance with NFPA 261 and shall have a char length not exceeding 38 mm.  
**Exceptions:**
1. Upholstered furniture belonging to the patient in sleeping rooms of nursing homes (Group I-2), provided that a smoke detector is installed in such rooms. Battery-powered, single-station smoke alarms shall be permitted.
  2. Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.5.2 Upholstered furniture heat release rate.** Newly introduced upholstered furniture shall have limited rates of heat release when tested in accordance with ASTM E 1537 or NFPA 266.
1. The peak rate of heat release for the single upholstered furniture item shall not exceed 250 kW.  
**Exception:** Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
  2. The total energy released by the single upholstered furniture item during the first 5 minutes of the test shall not exceed 40 mega joules (mJ).  
**Exception:** Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.5.3 Mattresses, heat-release rate.** Newly introduced mattresses in Group I-2 occupancies shall have limited rates of heat release when tested in accordance with ASTM E 1590 or NFPA 267.

1. The peak rate of heat release for the mattress shall not exceed 250 kW.  
**Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
  2. The total energy released by the mattress during the first 5 minutes of the test shall not exceed 40 mJ.  
**Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.5.4 Identification.** Upholstered furniture shall bear the label of an approved agency, confirming compliance with the requirements of Sections 6.3.5.1 and 6.3.5.2.
- 6.3.6 Group I-1, board and care facilities.** The requirements in Sections 6.3.6.1 through 6.3.6.3 shall apply to board and care facilities classified in Group I-1.
- 6.3.6.1 Upholstered furniture.** Newly introduced upholstered furniture shall meet the requirements for Class I when tested in accordance with NFPA 260.  
**Exception:** Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system.
- 6.3.6.2 Mattresses.** New mattresses shall have a char length not exceeding 50 mm.  
**Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system.
- 6.3.6.3 Mattresses, heat-release rate.** Newly introduced mattresses in Group I-1 occupancies shall have limited rates of heat release when tested in accordance with ASTM E 1590 or NFPA 267.
1. The peak rate of heat release for the mattress shall not exceed 250 kW.  
**Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system.
  2. The total energy released by the mattress during the first 5 minutes of the test shall not exceed 40 mJ.  
**Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system.
- 6.3.7 Group I-3, detention and correction facilities.** The requirements in Sections 6.3.7.1 through 6.3.7.6 shall apply to detention and correction facilities classified in Group I-3.
- 6.3.7.1 Upholstered furniture classification.** Newly introduced upholstered furniture shall meet the requirements for Class I where tested in accordance with NFPA 260.  
**Exception:** Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.7.2 Upholstered furniture heat release rate.** Newly introduced upholstered furniture shall have limited rates of heat release, as follows:
1. The peak rate of heat release for the single upholstered furniture item shall not exceed 250 kW.  
**Exceptions:**
    1. In Use Condition I, II and III occupancies, as defined in the SBC 201, upholstered furniture in rooms or spaces protected by approved smoke detectors that initiate, without delay, an alarm that is audible in that room or space.
    2. Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
  2. The total energy released by the single upholstered furniture item during the first 5 minutes of the test shall not exceed 40 mJ.

- Exception:** Upholstered furniture in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.7.3 Mattresses, char length.** Newly introduced mattresses shall have a char length not exceeding 50 mm.
- Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.7.4 Mattresses, heat release rate.** Newly introduced mattresses in detention and correctional occupancies shall have limited rates of heat release when tested in accordance with ASTM E 1590 or NFPA 267, as follows:
1. The peak rate of heat release for the mattress shall not exceed 250 kW.
- Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
2. The total energy released by the mattress during the first 5 minutes of the test shall not exceed 40 MJ.
- Exception:** Mattresses in rooms or spaces protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 6.3.7.5 Wastebaskets.** Wastebaskets and other waste containers shall be of non-combustible or other approved materials.
- 6.3.7.6 Wastebasket lids.** Waste containers with a capacity of more than 76 L shall be provided with a lid of noncombustible or other approved material.

## SECTION 6.4 DECORATIVE VEGETATION

- 6.4.1 Natural cut trees.** Natural cut trees, where permitted by this section, shall have the trunk bottoms cut off at least 12.7 mm above the original cut and shall be placed in a support device complying with Section 6.4.1.2.
- 6.4.1.1 Restricted occupancies.** Natural cut trees shall be prohibited in Group A, E, I-1, I-2, I-3, I-4, M, R-1, R-2 and R-4 occupancies.
- Exception:** Trees located in areas protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 shall not be prohibited in Groups A, E, M, R-1 and R-2.
- 6.4.1.2 Support devices.** The support device that holds the tree in an upright position shall be of a type that is stable and that meets all of the following criteria:
1. The device shall hold the tree securely and be of adequate size to avoid tipping over of the tree.
  2. The device shall be capable of containing a minimum 2 days supply of water.
  3. The water level, when full, shall cover the tree stem at least 50 mm. The water level shall be maintained above the fresh cut and checked at least once daily.
- 6.4.1.3 Dryness.** The tree shall be removed from the building whenever the needles or leaves fall off readily when a tree branch is shaken or if the needles are brittle and break when bent between the thumb and index finger. The tree shall be checked daily for dryness.
- 6.4.2 Obstruction of means of egress.** The required width of any portion of a means of egress shall not be obstructed by decorative vegetation.
- 6.4.3 Open flame.** Candles and open flames shall not be used on or near decorative vegetation. Natural cut trees shall be kept a distance from heat vents and any open flame or heat-producing devices at least equal to the height of the tree.



- 6.4.3.1 **Electrical fixtures and wiring.** The use of unlisted electrical wiring and lighting on decorative vegetation shall be prohibited.
- 6.4.4 **Artificial vegetation.** Artificial decorative vegetation shall be flame resistant or flame retardant. Such flame resistance or flame retardance shall be documented and certified by the manufacturer in an approved manner.
- 6.4.4.1 **Electrical fixtures and wiring.** The use of unlisted electrical wiring and lighting on decorative vegetation shall be prohibited. The use of electrical wiring and lighting on metal artificial trees shall be prohibited.

## SECTION 6.5 DECORATIONS AND TRIM

- 6.5.1 **General.** In occupancies of Groups A, E, I and R-1 and dormitories in Group R-2, curtains, draperies, hangings and other decorative materials suspended from walls or ceilings shall be flame resistant in accordance with Section 6.5.2 and NFPA 701 or be noncombustible.  
In Groups I-1 and I-2, combustible decorations shall be flame retardant unless the decorations, such as photographs and paintings, are of such limited quantities that a hazard of fire development or spread is not present. In Group I-3, combustible decorations are prohibited.
- 6.5.1.1 **Noncombustible materials.** The permissible amount of noncombustible decorative material shall not be limited.
- 6.5.1.2 **Flame-resistant materials.** The permissible amount of flame-resistant decorative materials shall not exceed 10 percent of the aggregate area of walls and ceilings.  
**Exception:** In auditoriums of Group A, the permissible amount of flame-resistant decorative material shall not exceed 50 percent of the aggregate area of walls and ceiling where the building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, and where the material is installed in accordance with Section 7.11 of SBC 201.
- 6.5.2 **Acceptance criteria and reports.** Where required to be flame resistant, decorative materials shall be tested by an approved agency and pass Test 1, as described in NFPA 701, or such materials shall be noncombustible. Reports of test results shall be prepared in accordance with NFPA 701 and furnished to the Building code official upon request.
- 6.5.3 **Foam plastic.** Foam plastic used as interior trim shall comply with Sections 6.5.3.1 through 6.5.3.4.
- 6.5.3.1 **Density.** The minimum density of the interior trim shall be 320 kg/m<sup>3</sup>.
- 6.5.3.2 **Thickness.** The maximum thickness of the interior trim shall be 12.7 mm and the maximum width shall be 200 mm.
- 6.5.3.3 **Area limitation.** The interior trim shall not constitute more than 10 percent of the aggregate wall and ceiling area of a room or space.
- 6.5.3.4 **Flame spread.** The flame spread rating shall not exceed 75 where tested in accordance with ASTM E 84. The smoke-developed index shall not be limited.
- 6.5.4 **Pyroxylin plastic.** Imitation leather or other material, consisting of or coated with a pyroxylin or similarly hazardous base, shall not be used in Group A occupancies.

- 6.5.5 Trim.** Material used as interior trim shall have a minimum Class C flame spread index and smoke-developed index. Combustible trim, excluding handrails and guardrails, shall not exceed 10 percent of the aggregate wall or ceiling area in which it is located.

## SECTION 6.6 INTERIOR FINISH AND DECORATIVE MATERIALS

- 6.6.1 General.** The provisions of this section shall limit the allowable flame spread and smoke development of interior finishes and decorative materials in existing buildings based on location and occupancy classification.

**Exceptions:**

1. Materials having a thickness less than 1.0 mm applied directly to the surface of walls and ceilings.
2. Exposed portions of structural members complying with the requirements of buildings of Type IV construction in accordance with the SBC 201 shall not be subject to interior finish requirements.

- 6.6.1.1 Requirements based on occupancy.** Interior finish and decorative materials shall be restricted by combustibility and flame resistance according to occupancy group in accordance with Table 6.6.3.

- 6.6.1.2 Foam plastics.** Cellular or foam plastics shall not be used as interior finish or trim.

**Exceptions:**

1. Cellular or foam plastic materials shall be permitted on the basis of fire tests that substantiate their combustibility characteristics for the use intended under actual fire conditions.
2. Cellular or foam plastic shall be permitted for trim not in excess of 10 percent of the wall or ceiling area, provided such trim is not less than 320 kg/m<sup>3</sup> in density, is limited to 12.7 mm in thickness and 200 mm in width, and complies with the requirements for Class A or B interior wall and ceiling finish except that the smoke rating shall not be limited.

- 6.6.1.3 Obstruction of means of egress.** No decorations or other objects shall be placed to obstruct exits, access thereto, egress there from, or visibility thereof.

- 6.6.2 Wall and ceiling finish.** Interior wall and ceiling finishes shall be classified in accordance with Section 7.11 of SBC 201. Such interior finishes shall be grouped in the following classes in accordance with their flame spread and smoke-developed index.

Class A: Flame spread index 0-25

Smoke-developed index 0-450

Class B: Flame spread index 26-75

Smoke-developed index 0-450

Class C: Flame spread index 76-450

Smoke-developed index 0-450

**Exception:** Materials, other than textiles, tested in accordance with Section 6.6.2.1.

- 6.6.2.1 Interior wall and ceiling finishes other than textiles.** Interior wall or ceiling finishes, other than textiles, shall be permitted to be tested in accordance with NFPA 286. Finishes tested in accordance with NFPA 286 shall comply with Section 6.6.2.1.1.

- 6.6.2.1.1 Acceptance criteria.** During the 40 kW exposure, the interior finish shall comply with Item 1. During the 160 kW exposure, the interior finish shall comply with Item 2. During the entire test, the interior finish shall comply with Item 3.

1. During the 40 kW exposure, flames shall not spread to the ceiling.
2. During the 160 kW exposure, the interior finish shall comply with the following:
  - 2.1 Flame shall not spread to the outer extremity of the sample on any wall or ceiling.
  - 2.2 Flashover, as defined in NFPA 286, shall not occur.
3. The total smoke released throughout the NFPA 286 test shall not exceed 1,000 m<sup>2</sup>.

**6.6.2.2 Stability.** Interior finish materials regulated by this chapter shall be applied or otherwise fastened in such a manner that such materials will not readily become detached when subjected to a room temperature of 93°C for not less than 30 minutes.

**6.6.2.3 Textiles.** Textile wall coverings shall have a Class A flame spread rating when tested in accordance with ASTM E 84 and be protected by approved automatic sprinklers installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 or the covering shall meet the criteria of Section 6.6.2.3.1 or 6.6.2.3.2 when tested in accordance with NFPA 265 using the product-mounting system, including adhesive, of actual use.

**6.6.2.3.1 Method A.** When using method A, flame shall not spread to the ceiling during a 40 kW exposure. During the 150 kW exposure, all of the following criteria shall be met:

1. Flame shall not spread to the outer extremity of the sample on the 2.4 m by 3.7 m wall.
2. The specimen shall not burn to the outer extremity of the 0.6-m-wide samples mounted vertically in the corner of the room.
3. Burning droplets that are judged by the Building Code official to be capable of igniting the textile wall covering or that persist in burning for 30 seconds or more shall not be formed and dropped to the floor.
4. Flashover, as defined in NFPA 265, shall not occur.
5. The maximum instantaneous net peak rate of heat release shall not exceed 300 kW.

**6.6.2.3.2 Method B.** When using method B, flame shall not spread to the ceiling during the 40 kW exposure. During the 150 kW exposure, all of the following criteria shall be met:

1. Flame shall not spread to the outer extremity of the sample on the 2.4 by 3.7 m wall.
2. Flashover, as defined in NFPA 265, shall not occur.

**6.6.2.4 Trim and incidental finish.** Interior wall and ceiling finish not in excess of 10 percent of the aggregate wall and ceiling areas of any room or space shall be permitted to be Class C materials.

**6.6.2.5 Expanded vinyl wall coverings.** Expanded vinyl wall coverings shall comply with the requirements for textile wall and ceiling materials and their use shall comply with Section 6.6.2.2.

**Exception:** Expanded vinyl wall or ceiling coverings complying with Section 6.6.2.1 shall not be required to comply with Sections 6.6.2 and 6.6.3.

**6.6.2.6 Fire-retardant coatings.** The required flame spread or smoke-developed classification of surfaces shall be permitted to be achieved by application of approved fire-retardant coatings, paints or solutions to surfaces having a flame spread rating exceeding that permitted. Such applications shall comply with NFPA 703 and the required fire-retardant properties shall be maintained or renewed in accordance with the manufacturer's instructions.

- 6.6.3 Wall and ceiling finish requirements.** Interior wall and ceiling finish shall have a flame spread index not greater than that specified in Table 6.6.3 for the group and location designated. Interior wall and ceiling finish materials, other than textiles, tested in accordance with NFPA 286 and meeting the acceptance criteria of Section 6.6.2.1.1, shall be permitted to be used where a Class A classification in accordance with ASTM E 84 is required.

**TABLE 6.6.3**  
**INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY<sup>k</sup>**

GROUP	SPRINKLERED <sup>m</sup>			NONSPRINKLERED		
	Vertical exits and exit passageways <sup>a, b</sup>	Exit access corridors and other exitways	Rooms and enclosed spaces <sup>c</sup>	Vertical exits and exit passageways <sup>a, b</sup>	Exit access corridors and other exitways	Rooms and enclosed spaces <sup>c</sup>
A-1 <sup>l</sup> & A-2	B	B	C	A	A <sup>d</sup>	B <sup>e</sup>
A-3 <sup>f, i</sup> , A-4, A-5	B	B	C	A	A <sup>d</sup>	C
B, E, M, R-1, R-4	B	C	C	A	B	C
F	C	C	C	B	C	C
H	B	B	C <sup>g</sup>	A	A	B
I-1	B	C	C	A	B	B
I-2	B	B	B <sup>h, i</sup>	A	A	B
I-3	A	A <sup>j</sup>	C	A	A	B
I-4	B	B	B <sup>h, i</sup>	A	A	B
R-2	C	C	C	B	B	C
R-3	C	C	C	C	C	C
S	C	C	C	B	B	C
U	No Restrictions			No Restrictions		

- Class C interior finish materials shall be permitted for wainscoting or paneling of not more than 93 m<sup>2</sup> of applied surface area in the grade lobby where applied directly to a noncombustible base or over furring strips applied to a noncombustible base and fire blocked as required by Section 7.11 of SBC 201.
- In vertical exits of buildings less than three stories in height of other than Group I-3, Class B interior finish for unsprinklered buildings and Class C for sprinklered buildings shall be permitted.
- Requirements for rooms and enclosed spaces shall be based upon spaces enclosed by partitions. Where a fire-resistance rating is required for structural elements, the enclosing partitions shall extend from the floor to the ceiling. Partitions that do not comply with this shall be considered as enclosing spaces and the rooms or spaces on both sides shall be considered as one. In determining the applicable requirements for rooms and enclosed spaces, the specific occupancy thereof shall be the governing factor regardless of the group classification of the building or structure.
- Lobby areas in Group A-1, A-2 and A-3 occupancies shall not be less than Class B.
- Class C interior finish materials shall be permitted in Group A occupancies with an occupant load of 300 persons or less.
- For mosques and places of worship, wood used for ornamental purposes, trusses, paneling, or chancel furnishing shall be permitted.
- Class B required where building exceeds two stories.
- Class C interior finish materials shall be permitted in administrative spaces.
- Class C interior finish materials shall be permitted in rooms with a capacity of four persons or less.
- Class B materials shall be permitted as wainscoting extending not more than 1,219 mm above the finished floor in exit access corridors.
- Finish materials as provided for in other sections of these code requirements.
- Motion picture screens shall comply with Section 6.3.2.2.
- Applies when the vertical exits, exit passageways, exit access corridors or exitways, or rooms and spaces are protected by a sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

## CHAPTER 7 FIRE PROTECTION SYSTEMS

### SECTION 7.1 GENERAL

- 7.1.1 Scope.** The provisions of this chapter shall specify where fire protection systems are required and shall apply to the design, installation, inspection, operation, testing and maintenance of all fire protection systems.
- 7.1.2 Construction documents.** The Building official shall have the authority to require construction documents and calculations for all fire protection systems and to require permits be issued for the installation, rehabilitation or modification of any fire protection system. Construction documents for fire protection systems shall be submitted for review and approval prior to system installation.
- 7.1.2.1 Statement of compliance.** Before requesting final approval of the installation, where required by the Building official, the installing contractor shall furnish a written statement to the Building official that the subject fire protection system has been installed in accordance with approved plans and has been tested in accordance with the manufacturer's specifications and the appropriate installation standard. Any deviations from the design standards shall be noted and copies of the approvals for such deviations shall be attached to the written statement.
- 7.1.3 Permits.** Permits shall be required as set forth in SBC 100.
- 7.1.4 Installation.** Fire protection systems shall be maintained in accordance with the original installation standards for that system. Required systems shall be extended, altered, or augmented as necessary to maintain and continue protection whenever the building is altered, remodeled or added to. Alterations to fire protection systems shall be done in accordance with applicable standards.
- 7.1.4.1 Required fire protection systems.** Fire protection systems required by these code requirements or the SBC 201 shall be installed, repaired, operated, tested and maintained in accordance with these code requirements.
- 7.1.4.2 Nonrequired fire protection systems.** Any fire protection system or portion thereof not required by these code requirements or the SBC 201 shall be allowed to be furnished for partial or complete protection provided such installed system meets these code requirements and the SBC 201.
- 7.1.4.3 Additional fire protection systems.** In occupancies of a hazardous nature, where special hazards exist in addition to the normal hazards of the occupancy, or where the Building official determines that access for fire apparatus is unduly difficult, the Building official shall have the authority to require additional safeguards. Such safeguards include, but shall not be limited to, the following: automatic fire detection systems, fire alarm systems, automatic fire-extinguishing systems, standpipe systems, or portable or fixed extinguishers. Fire protection equipment required under this section shall be installed in accordance with these code requirements and the applicable referenced standards.
- 7.1.4.4 Appearance of equipment.** Any device that has the physical appearance of life safety or fire protection equipment but that does not perform that life safety or fire protection function, shall be prohibited.
- 7.1.5 Installation acceptance testing.** Fire detection and alarm systems, fire-extinguishing systems, fire hydrant systems, fire standpipe systems, fire pump

systems, private fire service mains and all other fire protection systems and appurtenances thereto shall be subject to acceptance tests as contained in the installation standards and as approved by the Building official. The Building official shall be notified before any required acceptance testing.

**7.1.5.1 Occupancy.** It shall be unlawful to occupy any portion of a building or structure until the required fire detection, alarm and suppression systems have been tested and approved.

**7.1.6 Inspection, testing and maintenance.** Fire detection, alarm and extinguishing systems shall be maintained in an operative condition at all times, and shall be replaced or repaired where defective. Nonrequired fire protection systems and equipment shall be inspected, tested and maintained or removed.

**7.1.6.1 Standards.** Fire protection systems shall be inspected, tested and maintained in accordance with the referenced standards listed in Table 7.1.6.1.

**TABLE 7.1.6.1  
FIRE PROTECTION SYSTEM MAINTENANCE STANDARDS**

SYSTEM	STANDARD
Portable fire extinguishers	NFPA 10
Carbon dioxide fire-extinguishing system	NFPA 12
Halon 1301 fire-extinguishing systems	NFPA 12A
Dry-chemical extinguishing systems	NFPA 17
Wet-chemical extinguishing systems	NFPA 17A
Water-based fire protection systems	NFPA 25
Fire alarm systems	NFPA 72
Water-mist systems	NFPA 750
Clean-agent extinguishing systems	NFPA 2001

**7.1.6.2 Records.** Records of all system inspections, tests, and maintenance required by the referenced standards shall be maintained on the premises for a minimum of 3 years and made available to the Building official upon request.

**7.1.7 Systems out of service.** Where a required fire protection system is out of service, the Civil Defence and the Building official shall be notified immediately and, where required by the Building official, the building shall either be evacuated or an approved fire watch shall be provided for all occupants left unprotected by the shut down until the fire protection system has been returned to service.

Where utilized, fire watches shall be provided with at least one approved means for notification of the Civil Defence and their only duty shall be to perform constant patrols of the protected premises and keep watch for fires.

**7.1.7.1 Impairment coordinator.** The building owner shall assign an impairment coordinator to comply with the requirements of this section. In the absence of a specific designee, the owner shall be considered the impairment coordinator.

**7.1.7.2 Tag required.** A tag shall be used to indicate that a system, or portion thereof, has been removed from service.

**7.1.7.3 Placement of tag.** The tag shall be posted at each Civil Defence connection, system control valve, fire alarm control unit, fire alarm annunciator and fire command center, indicating which system, or part thereof, has been removed from service. The Building official shall specify where the tag is to be placed.

**7.1.7.4 Preplanned impairment programs.** Preplanned impairments shall be authorized

by the impairment coordinator. Before authorization is given, a designated individual shall be responsible for verifying that all of the following procedures have been implemented:

1. The extent and expected duration of the impairment have been determined.
2. The areas or buildings involved have been inspected and the increased risks determined.
3. Recommendations have been submitted to management or building owner/manager.
4. The Civil Defence has been notified.
5. The insurance carrier, the alarm company, building owner/manager, and other authorities having jurisdiction have been notified.
6. The supervisors in the areas to be affected have been notified.
7. A tag impairment system has been implemented.
8. Necessary tools and materials have been assembled on the impairment site.

**7.1.7.5 Emergency impairments.** When unplanned impairments occur, appropriate emergency action shall be taken to minimize potential injury and damage. The impairment coordinator shall implement the steps outlined in Section 7.1.7.4.

**7.1.7.6 Restoring systems to service.** When impaired equipment is restored to normal working order, the impairment coordinator shall verify that all of the following procedures have been implemented:

1. Necessary inspections and tests have been conducted to verify that affected systems are operational.
2. Supervisors have been advised that protection is restored.
3. The Civil Defence has been advised that protection is restored.
4. The building owner/manager, insurance carrier, alarm company, and other involved parties have been advised that protection is restored.
5. The impairment tag has been removed.

**7.1.8 Removal of or tampering with equipment.** It shall be unlawful for any person to remove, tamper with or otherwise disturb any fire hydrant, fire detection and alarm system, fire suppression system, or other fire appliance required by these code requirements except for the purpose of extinguishing fire, training purposes, recharging or making necessary repairs, or when approved by the Building official.

**7.1.8.1 Removal of or tampering with appurtenances.** Locks, gates, doors, barricades, chains, enclosures, signs, tags or seals which have been installed by or at the direction of the Building official shall not be removed, unlocked, destroyed, tampered with or otherwise vandalized in any manner.

**7.1.9 Modifications.** No person shall remove or modify any fire protection system installed or maintained under the provisions of these code requirements or the SBC 201 without approval by the building official.

**7.1.10 Threads.** Threads provided for fire department connections to sprinkler systems, standpipes, yard hydrants or any other fire hose connection shall be compatible with the connections used by the local Civil Defence.

**7.1.11 Acceptance tests.** Fire protection systems shall be tested in accordance with the requirements of these code requirements and the SBC 201. When required, the tests shall be conducted in the presence of the building official. Tests required by these code requirements, the SBC 201 and the standards listed in these code requirements shall be conducted at the expense of the owner or the owner's

representative. It shall be unlawful to occupy portions of a structure until the required fire protection systems within that portion of the structure have been tested and approved.

- 7.1.12 Supervisory service.** Where required, fire protection systems shall be monitored by an approved supervising station in accordance with NFPA 72.
- 7.1.12.1 Automatic sprinkler systems.** Automatic sprinkler systems shall be monitored by an approved supervising station.
- Exceptions:**
1. A supervising station is not required for automatic sprinkler systems protecting one- and two-family dwellings.
  2. Limited area systems serving fewer than 20 sprinklers.
- 7.1.12.2 Fire alarm systems.** Fire alarm systems required by the provisions of Section 7.7.2 of these code requirements shall be monitored by an approved supervising station in accordance with Section 7.7.15.
- Exceptions:**
1. Single- and multiple-station smoke alarms required by Section 7.7.2.10.
  2. Smoke detectors in Group I-3 occupancies.
  3. Supervisory service is not required for automatic sprinkler systems in one- and two-family dwellings.
- 7.1.12.3 Group H.** Manual fire alarm, automatic fire-extinguishing and emergency alarm systems in Group H occupancies shall be monitored by an approved supervising station.
- Exception:** When approved by the building official, on-site monitoring at a constantly attended location shall be permitted provided that notifications to the fire department will be equal to those provided by an approved supervising station.
- 7.1.13 Fire areas.** Where buildings, or portions thereof, are divided into fire areas so as not to exceed the limits established for requiring a fire protection system in accordance with this chapter, such fire areas shall be separated by fire barriers having a fire-resistance rating of not less than that determined in accordance with Section 4.6.3.7 of the SBC 201.

## SECTION 7.2 DEFINITIONS

- 7.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**ALARM NOTIFICATION APPLIANCE.** A fire alarm system component such as a bell, horn, speaker, light, or text display that provides audible, tactile, or visible outputs, or any combination thereof.

**ALARM SIGNAL.** A signal indicating an emergency requiring immediate action, such as a signal indicative of fire.

**ALARM VERIFICATION FEATURE.** A feature of automatic fire detection and alarm systems to reduce unwanted alarms wherein smoke detectors report alarm conditions for a minimum period of time, or confirm alarm conditions within a given time period, after being automatically reset, in order to be accepted as a valid alarm-initiation signal.



**ANNUNCIATOR.** A unit containing one or more indicator lamps, alphanumeric displays, or other equivalent means in which each indication provides status information about a circuit, condition or location.

**AUDIBLE ALARM NOTIFICATION APPLIANCE.** A notification appliance that alerts by the sense of hearing.

**AUTOMATIC.** As applied to fire protection devices, is a device or system providing an emergency function without the necessity for human intervention and activated as a result of a predetermined temperature rise, rate of temperature rise, or combustion products.

**AUTOMATIC FIRE-EXTINGUISHING SYSTEM.** An approved system of devices and equipment which automatically detects a fire and discharges an approved fire-extinguishing agent onto or in the area of a fire.

**AUTOMATIC SPRINKLER SYSTEM.** A sprinkler system, for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable water supply. The portion of the system above the ground is a network of specially sized or hydraulically designed piping installed in a structure or area, generally overhead, and to which automatic sprinklers are connected in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area.

**AVERAGE AMBIENT SOUND LEVEL.** The root mean square, A-weighted sound pressure level measured over a 24-hour period.

**CARBON DIOXIDE EXTINGUISHING SYSTEM.** A system supplying carbon dioxide (CO<sub>2</sub>) from a pressurized vessel through fixed pipes and nozzles. The system includes a manual or automatic-actuating mechanism.

**CLEAN AGENT.** Electrically non-conducting, volatile, or gaseous fire extinguishant that does not leave a residue upon evaporation.

**CONSTANTLY ATTENDED LOCATION.** A designated location at a facility staffed by trained personnel on a continuous basis where alarm or supervisory signals are monitored and facilities are provided for notification of the Civil Defence or other emergency services.

**DELUGE SYSTEM.** A sprinkler system employing open sprinklers attached to a piping system connected to a water supply through a valve that is opened by the operation of a detection system installed in the same area as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto.

**DETECTOR, HEAT.** A fire detector that senses heat produced by burning substances. Heat is the energy produced by combustion that causes substances to rise in temperature.

**DRY-CHEMICAL EXTINGUISHING AGENT.** A powder composed of small particles, usually of sodium bicarbonate, potassium bicarbonate, urea-potassium-

based bicarbonate, potassium chloride or monoammonium phosphate, with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking) and the proper flow capabilities.

**EMERGENCY ALARM SYSTEM.** A system to provide indication and warning of emergency situations involving hazardous materials.

**EMERGENCY VOICE/ALARM COMMUNICATIONS.** Dedicated manual or automatic facilities for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building.

**FIRE ALARM BOX, MANUAL.** See “Manual fire alarm box.”

**FIRE ALARM CONTROL UNIT.** A system component that receives inputs from automatic and manual fire alarm devices and is capable of supplying power to detection devices and transponder(s) of off-premises transmitter(s). The control unit is capable of providing a transfer of power to the notification appliances and transfer of condition to relays of devices.

**FIRE ALARM SIGNAL.** A signal initiated by a fire alarm-initiating device such as a manual fire alarm box, automatic fire detector, water-flow switch, or other device whose activation is indicative of the presence of a fire or fire signature.

**FIRE ALARM SYSTEM.** A system or portion of a combination system consisting of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices and to initiate the appropriate response to those signals.

**FIRE AREA.** The aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls, or fire-resistance-rated horizontal assemblies of a building.

**FIRE DETECTOR, AUTOMATIC.** A device designed to detect the presence of a fire signature and to initiate action.

**FIRE PROTECTION SYSTEM.** Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof.

**FIRE SAFETY FUNCTIONS.** Building and fire control functions that are intended to increase the level of life safety for occupants or to control the spread of the harmful effects of fire.

**FOAM-EXTINGUISHING SYSTEM.** A special system discharging a foam made from concentrates, either mechanically or chemically, over the area to be protected.

**HALOGENATED EXTINGUISHING SYSTEM.** A fire-extinguishing system using one or more atoms of an element from the halogen chemical series: fluorine, chlorine, bromine and iodine.

**IMPAIRMENT COORDINATOR.** The person responsible for the maintenance of a particular fire protection system.

**INITIATING DEVICE.** A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box, or supervisory switch.

**LISTED.** Equipment, materials or services included in a list published by an organization acceptable to the building official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material or service meets identified standards or has been tested and found suitable for a specified purpose.

**MANUAL FIRE ALARM BOX.** A manually operated device used to initiate an alarm signal.

**MULTIPLE-STATION ALARM DEVICE.** Two or more single-station alarm devices that can be interconnected such that actuation of one causes all integral or separate audible alarms to operate. It also can consist of one single-station alarm device having connections to other detectors or to a manual fire alarm box.

**MULTIPLE-STATION SMOKE ALARM.** Two or more single-station alarm devices that are capable of interconnection such that actuation of one causes all integral or separate audible alarms to operate.

**NUISANCE ALARM.** An alarm caused by mechanical failure, malfunction, improper installation, or lack of proper maintenance, or an alarm activated by a cause that cannot be determined.

**RECORD DRAWINGS.** Drawings (“as built”) that document the location of all devices, appliances, wiring, sequences, wiring methods, and connections of the components of a fire alarm system as installed.

**SINGLE-STATION SMOKE ALARM.** An assembly incorporating the detector, the control equipment, and the alarm-sounding device in one unit, operated from a power supply either in the unit or obtained at the point of installation.

**SLEEPING UNIT.** A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not sleeping units.

**SMOKE ALARM.** A single or multiple-station alarm responsive to smoke and not connected to a system.

**SMOKE DETECTOR.** A listed device that senses visible or invisible particles of combustion.

**SMOKEPROOF ENCLOSURE.** An exit stairway designed and constructed so that the movement of the products of combustion produced by a fire occurring in any part of the building into the enclosure is limited.

**STANDPIPE SYSTEM, CLASSES OF.** Standpipe classes are as follows:

**Class I system.** A system providing 65 mm hose connections to supply water for use by Civil Defence and those trained in handling heavy fire streams.

**Class II system.** A system providing 40 mm hose stations to supply water for use primarily by the building occupants or by the Civil Defence during initial response.

**Class III system.** A system providing 40 mm hose stations to supply water for use by building occupants and 65 mm hose connections to supply a larger volume of water for use by fire departments and those trained in handling heavy fire streams.

**STANDPIPE, TYPES OF.** Standpipe types are as follows:

**Automatic dry.** A dry standpipe system, normally filled with pressurized air, that is arranged through the use of a device, such as a dry pipe valve, to admit water into the system piping automatically upon the opening of a hose valve. The water supply for an automatic dry standpipe system shall be capable of supplying the system demand.

**Automatic wet.** A wet standpipe system that has a water supply that is capable of supplying the system demand automatically.

**Manual dry.** A dry standpipe system that does not have a permanent water supply attached to the system. Manual dry standpipe systems require water from a fire department pumper to be pumped into the system through the Civil Defence connection in order to supply the system demand.

**Manual wet.** A wet standpipe system connected to a water supply for the purpose of maintaining water within the system but which does not have a water supply capable of delivering the system demand attached to the system. Manual wet standpipe systems require water from a Civil Defence pumper (or the like) to be pumped into the system in order to supply the system demand.

**Semi-automatic dry.** A dry standpipe system that is arranged through the use of a device, such as a deluge valve, to admit water into the system piping upon activation of a remote control device located at a hose connection. A remote control activation device shall be provided at each hose connection. The water supply for a semi-automatic dry standpipe system shall be capable of supplying the system demand.

**SUPERVISING STATION.** A facility that receives signals and at which personnel are in attendance at all times to respond to these signals.

**SUPERVISORY SERVICE.** The service required to monitor performance of guard tours and the operative condition of fixed suppression systems or other systems for the protection of life and property.

**SUPERVISORY SIGNAL.** A signal indicating the need of action in connection with the supervision of guard tours, the fire suppression systems or equipment, or the maintenance features of related systems.

**SUPERVISORY SIGNAL-INITIATING DEVICE.** An initiating device such as a valve supervisory switch, water level indicator, or low-air pressure switch on

a dry-pipe sprinkler system whose change of state signals an off-normal condition and its restoration to normal of a fire protection or life safety system; or a need for action in connection with guard tours, fire suppression systems or equipment, or maintenance features of related systems.

**TIRES, BULK STORAGE OF.** Storage of tires where the area available for storage exceeds 566 m<sup>3</sup>.

**TROUBLE SIGNAL.** A signal initiated by the fire alarm system or device indicative of a fault in a monitored circuit or component.

**VISIBLE ALARM NOTIFICATION APPLIANCE.** A notification appliance that alerts by the sense of sight.

**WET-CHEMICAL EXTINGUISHING AGENT.** A solution of water and potassium-carbonate-based chemical, potassium-acetate-based chemical or a combination thereof, forming an extinguishing agent.

**WIRELESS PROTECTION SYSTEM.** A system or a part of a system that can transmit and receive signals without the aid of wire.

**ZONE.** A defined area within the protected premises. A zone can define an area from which a signal can be received, an area to which a signal can be sent, or an area in which a form of control can be executed.

### SECTION 7.3 AUTOMATIC SPRINKLER SYSTEMS

**7.3.1 General.** Automatic sprinkler systems shall comply with this section.

**7.3.1.1 Alternative protection.** Alternative automatic fire-extinguishing systems complying with Section 7.4 shall be permitted in lieu of automatic sprinkler protection where recognized by the applicable standard and approved by the Building official.

**7.3.2 Where required.** Approved automatic sprinkler systems in new buildings and structures shall be provided in the locations described in this section.

**Exception:** Spaces or areas in telecommunications buildings used exclusively for telecommunications equipment, associated electrical power distribution equipment, batteries and standby engines, provided those spaces or areas are equipped throughout with an automatic fire alarm system and are separated from the remainder of the building by a wall with a fire-resistance rating of not less than 1 hour and a floor/ceiling assembly with a fire-resistance rating of not less than 2 hours.

**7.3.2.1 Group A.** An automatic sprinkler system shall be provided throughout buildings and portions thereof used as Group A occupancies as provided in this section. For Group A-1, A-2, A-3, and A-4 occupancies, the automatic sprinkler system shall be provided throughout the floor area where the Group A-1, A-2, A-3 or A-4 occupancy is located, and in all floors between the Group A occupancy and the level of exit discharge. For group A-5 occupancies, the automatic sprinkler system shall be provided in the spaces indicated in Section 7.3.2.1.5.

**7.3.2.1.1 Group A-1.** An automatic sprinkler system shall be provided for Group A-1 occupancies where one of the following conditions exists:

1. The fire area exceeds 1,115 m<sup>2</sup>;
2. The fire area has an occupant load of 300 or more;
3. The fire area is located on a floor other than the level of exit discharge; or
4. The fire area contains a multitheater complex.

**7.3.2.1.2 Group A-2.** An automatic sprinkler system shall be provided for Group A-2 occupancies where one of the following conditions exists:

1. The fire area exceeds 465 m<sup>2</sup>;
2. The fire area has an occupant load of 300 or more; or
3. The fire area is located on a floor other than the level of exit discharge.

**7.3.2.1.3 Group A-3.** An automatic sprinkler system shall be provided for Group A-3 occupancies where one of the following conditions exists:

1. The fire area exceeds 1.1 m<sup>2</sup>;
2. The fire area has an occupant load of 300 or more; or
3. The fire area is located on a floor other than the level of exit discharge.

**Exception:** Areas used exclusively as participant sports areas where the main floor area is located at the same level as the level of exit discharge of the main entrance and exit.

**7.3.2.1.4 Group A-4.** An automatic sprinkler system shall be provided for Group A-4 occupancies where one of the following conditions exists:

1. The fire area exceeds 1.1 m<sup>2</sup>;
2. The fire area has an occupant load of 300 or more; or
3. The fire area is located on a floor other than the level of exit discharge.

**Exception:** Areas used exclusively as participant sports areas where the main floor area is located at the same level as the level of exit discharge of the main entrance and exit.

**7.3.2.1.5 Group A-5.** An automatic sprinkler system shall be provided in concession stands, retail areas, press boxes, and other accessory use areas in excess of 93 m<sup>2</sup>.

**7.3.2.2 Group E.** An automatic sprinkler system shall be provided for Group E occupancies as follows:

1. Throughout all Group E fire areas greater than 1.9 m<sup>2</sup> in area.
2. Throughout every portion of educational buildings below the level of exit discharge.

**Exception:** An automatic sprinkler system is not required in any fire area or area below the level of exit discharge where every classroom throughout the building has at least one exterior exit door at ground level.

**7.3.2.3 Group F-1.** An automatic sprinkler system shall be provided throughout all buildings containing a Group F-1 occupancy where one of the following conditions exist:

1. Where a Group F-1 fire area exceeds 1.1 m<sup>2</sup>;
2. Where a Group F-1 fire area is located more than three stories above grade; or
3. Where the combined area of all Group F-1 fire areas on all floors, including any mezzanines, exceeds 2.2 m<sup>2</sup>.

**7.3.2.3.1 Woodworking operations.** An automatic sprinkler system shall be provided throughout all Group F-1 occupancy fire areas that contain woodworking operations in excess of 232 m<sup>2</sup> which generate finely divided combustible waste or which use finely divided combustible materials.

**7.3.2.4 Group H.** Automatic sprinkler systems shall be provided in high-hazard occupancies as required in Sections 7.3.2.4.1 through 7.3.2.4.3.

**7.3.2.4.1 General.** An automatic sprinkler system shall be installed in Group H occupancies.

**7.3.2.4.2 Group H-5 occupancies.** An automatic sprinkler system shall be installed throughout buildings containing Group H-5 occupancies. The design of the

sprinkler system shall not be less than that required under the SBC 201 for the occupancy hazard classifications in accordance with Table 7.3.2.4.2.

Where the design area of the sprinkler system consists of a corridor protected by one row of sprinklers, the maximum number of sprinklers required to be calculated is 13.

- 7.3.2.4.3 Pyroxylin plastics.** An automatic sprinkler system shall be provided in buildings, or portions thereof, where cellulose nitrate film or pyroxylin plastics are manufactured, stored or handled in quantities exceeding 45 kg.

**TABLE 7.3.2.4.2  
GROUP H-5 SPRINKLER DESIGN CRITERIA**

LOCATION	OCCUPANCY HAZARD CLASSIFICATION
Fabrication areas	Ordinary Hazard Group 2
Service corridors	Ordinary Hazard Group 2
Storage rooms without dispensing	Ordinary Hazard Group 2
Storage rooms with dispensing	Extra Hazard Group 2
Corridors	Ordinary Hazard Group 2

- 7.3.2.5 Group I.** An automatic sprinkler system shall be provided throughout buildings with a Group I fire area.

**Exception:** An automatic sprinkler system installed in accordance with Section 7.3.3.1.2 or 7.3.3.1.3 shall be allowed in Group I-1 facilities.

- 7.3.2.6 Group M.** An automatic sprinkler system shall be provided throughout buildings containing a Group M occupancy where one of the following conditions exists:

1. Where a Group M fire area exceeds 1.1 m<sup>2</sup>;
2. Where a Group M fire area is located more than three stories above grade; or
3. Where the combined area of all Group M fire areas on all floors, including any mezzanines, exceeds 2,230 m<sup>2</sup>.

- 7.3.2.6.1 High-piled storage.** An automatic sprinkler system shall be provided as required in Chapter 21 in all buildings of Group M where storage of merchandise is in high-piled or rack storage arrays.

- 7.3.2.7 Group R.** An automatic sprinkler system installed in accordance with Section 7.3.3 shall be provided throughout all buildings with a Group R fire area.

- 7.3.2.8 Group S-1.** An automatic sprinkler system shall be provided throughout all buildings containing a Group S-1 occupancy where one of the following conditions exist:

1. Where a Group S-1 fire area exceeds 1.1 m<sup>2</sup>;
2. Where a Group S-1 fire area is located more than three stories above grade; or
3. Where the combined area of all Group S-1 fire areas on all floors, including any mezzanines, exceeds 2,230 m<sup>2</sup>.

- 7.3.2.8.1 Repair garages.** An automatic sprinkler system shall be provided throughout all buildings used as repair garages in accordance with the SBC 201, as follows:

1. Buildings two or more stories in height, including basements, with a fire area containing a repair garage exceeding 929 m<sup>2</sup>.
2. One-story buildings with a fire area containing a repair garage exceeding 1.1 m<sup>2</sup>.
3. Buildings with a repair garage servicing vehicles parked in the basement.

- 7.3.2.8.2 Bulk storage of tires.** Buildings and structures where the area for the storage of tires exceeds 566 m<sup>3</sup> shall be equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

- 7.3.2.9 Group S-2.** An automatic sprinkler system shall be provided throughout buildings classified as an enclosed parking garage in accordance with the SBC 201 or where located beneath other groups.  
**Exception:** Enclosed parking garages located beneath Group R-3 occupancies.
- 7.3.2.9.1 Commercial parking garages.** An automatic sprinkler system shall be provided throughout buildings used for storage of commercial trucks or buses where the fire area exceeds 464 m<sup>2</sup>.
- 7.3.2.10 All occupancies except Groups R-3 and U.** An automatic sprinkler system shall be installed in the locations set forth in Sections 7.3.2.10.1 through 7.3.2.10.1.3.  
**Exception:** Group R-3 and Group U.
- 7.3.2.10.1 Stories and basements without openings.** An automatic sprinkler system shall be installed in every story or basement of all buildings where the floor area exceeds 140 m<sup>2</sup> and where there is not provided at least one of the following types of exterior wall openings:
1. Openings below grade that lead directly to ground level by an exterior stairway complying with Section 8.9 or an outside ramp complying with Section 8.10. Openings shall be located in each 15.2 m, or fraction thereof, of exterior wall in the story on at least one side.
  2. Openings entirely above the adjoining ground level totaling at least 1.86 m<sup>2</sup> in each 15.2, or fraction thereof, of exterior wall in the story on at least one side.
- 7.3.2.10.1.1 Opening dimensions and access.** Openings shall have a minimum dimension of not less than 762 mm. Such openings shall be accessible to the Civil Defence from the exterior and shall not be obstructed in a manner that fire fighting or rescue cannot be accomplished from the exterior.
- 7.3.2.10.1.2 Openings on one side only.** Where openings in a story are provided on only one side and the opposite wall of such story is more than 23.0 m from such openings, the story shall be equipped throughout with an approved automatic sprinkler system or openings as specified above shall be provided on at least two sides the story.
- 7.3.2.10.1.3 Basements.** Where any portion of a basement is located more than 23.0 m from openings required by Section 7.3.2.10.1, the basement shall be equipped throughout with an approved automatic sprinkler system.
- 7.3.2.10.2 Rubbish and linen chutes.** An automatic sprinkler system shall be installed at the top of rubbish and linen chutes and in their terminal rooms. Chutes extending through three or more floors shall have additional sprinkler heads installed within such chutes at alternate floors. Chute sprinklers shall be accessible for servicing.
- 7.3.2.10.3 Buildings more than 16.8 meters in height.** An automatic sprinkler system shall be installed throughout buildings with a floor level having an occupant load of 30 or more that is located 16.8 m or more above the lowest level of Civil Defence vehicle access.  
**Exceptions:**
1. Airport control towers.
  2. Open parking structures.
  3. Occupancies in Group F-2.
- 7.3.2.11 During construction.** Automatic sprinkler systems required during construction, alteration and demolition operations shall be provided in accordance with Section 10.13.
- 7.3.2.12 Other hazards.** Automatic sprinkler protection shall be provided for the hazards indicated in Sections 7.3.2.12.1 and 7.3.2.12.2.
- 7.3.2.12.1 Ducts conveying hazardous exhausts.** Where required by the SBC 501, automatic sprinklers shall be provided in ducts conveying hazardous exhaust, flammable or combustible materials.



**Exception:** Ducts where the largest cross-sectional diameter of the duct is less than 254 mm.

**7.3.2.12.2 Commercial cooking operations.** An automatic sprinkler system shall be installed in a commercial kitchen exhaust hood and duct system where an automatic sprinkler system is used to comply with Section 7.4.

**7.3.2.13 Other required suppression systems.** In addition to the requirements of Section 7.3.2, the provisions indicated in Table 7.3.2.13 also require the installation of a suppression system for certain buildings and areas.

**TABLE 7.3.2.13  
ADDITIONAL REQUIRED FIRE-EXTINGUISHING SYSTEMS**

SECTION	SUBJECT
8.24.6.2.3	Smoke-protected seating
12.4.1	Spray finishing in Group A, E, I or R
12.4.6	Spray booths and rooms
12.5.1	Dip-tank rooms
12.5.6.1	Dip tanks
12.5.8.4	Hardening and tempering tanks
13.8.2	Dry cleaning plants
13.8.3	Dry cleaning machines
16.3.10	HPM facilities
16.3.10.1.1	HPM work station exhaust
16.3.10.2	HPM gas cabinets
16.3.10.3	HPM corridors
16.3.10.4	HPM exhaust
16.3.10.4	HPM noncombustible ducts
16.3.10.4.2	HPM combustible ducts
17.7.3	Lumber production conveyor rooms
17.8.7	Recycling facility conveyor rooms
19.6.1	Class A and B ovens
19.6.2	Class C and D ovens
Table 21.6.2	Storage fire protection
21.6.4	Storage
25.3.8.4.1	Gas rooms
25.3.8.5.3	Exhausted enclosures
25.4.5	Indoor storage of hazardous materials
25.5.1.8	Indoor dispensing of hazardous materials
26.4.4.1	Aerosol warehouses
27.4.5	Storage of more than 28 m <sup>3</sup> of loose combustible fibers
31.6.5.2.1	Storage of smokeless propellant
31.6.5.2.3	Storage of small arms primers
32.4.3.7.5.1	Flammable and combustible liquid storage rooms
32.4.3.8	Flammable and combustible liquid storage warehouses
32.5.3.7.3	Flammable and combustible liquid Group H-2 or H-3 areas
35.4.1.2	Gas cabinets for highly toxic and toxic gas
35.4.1.3	Exhausted enclosures for highly toxic and toxic gas

(Continued)

**TABLE 7.3.2.13 – continued**  
**ADDITIONAL REQUIRED FIRE-EXTINGUISHING SYSTEMS**

SECTION	SUBJECT
35.4.2.2.6	Gas rooms for highly toxic and toxic gas
35.4.3.3	Outdoor storage for highly toxic and toxic gas
39.6.2.2	Exhausted enclosures or gas cabinets for silane gas
40.4.1.1	Pyroxylin plastic storage cabinets
40.4.1.3	Pyroxylin plastic storage vaults
40.4.2	Pyroxylin plastic storage and manufacturing

- 7.3.3 Installation requirements.** Automatic sprinkler systems shall be designed and installed in accordance with Sections 7.3.3.1 through 7.3.3.7.
- 7.3.3.1 Standards.** Sprinkler systems shall be designed and installed in accordance with Section 7.3.3.1.1, 7.3.3.1.2 or 7.3.3.1.3.
- 7.3.3.1.1 Sprinkler systems.** Where the provisions of these code requirements require that a building or portion thereof be equipped throughout with an automatic sprinkler system in accordance with this section, sprinklers shall be installed throughout in accordance with NFPA 13 except as provided in Section 7.3.3.1.1.1.
- 7.3.3.1.1.1 Exempt locations.** Automatic sprinklers shall not be required in the following rooms or areas where such rooms or areas are protected with an approved automatic fire detection system in accordance with Section 7.7.2 that will respond to visible or invisible particles of combustion. Sprinklers shall not be omitted from any room merely because it is damp, of fire-resistance rated construction or contains electrical equipment.
1. Any room where the application of water, or flame and water, constitutes a serious life or fire hazard.
  2. Any room or space where sprinklers are considered undesirable because of the nature of the contents, when approved by the Building official.
  3. Generator and transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.
  4. In rooms or areas that are of noncombustible construction with wholly noncombustible contents.
- 7.3.3.1.2 Sprinkler systems.** Where allowed in buildings of Group R, up to and including four stories in height, automatic sprinkler systems shall be installed throughout in accordance with NFPA 13R.
- 7.3.3.1.2.1 Balconies.** Sprinkler protection shall be provided for exterior balconies and ground floor patios of dwelling units where the building is of Type V construction. Sidewall sprinklers that are used to protect such areas shall be permitted to be located such that their deflectors are within 25 mm to 150 mm below the structural members, and a maximum distance of 350 mm below the deck of the exterior balconies that are constructed of open wood joist construction.
- 7.3.3.1.3 Sprinkler systems.** Where allowed, automatic sprinkler systems installed in one- and two-family dwellings shall be installed throughout in accordance with NFPA 13D.
- 7.3.3.2 Quick-response and residential sprinklers.** Where automatic sprinkler systems are required by these code requirements, quick-response or residential automatic sprinklers shall be installed in the following areas in accordance with Section 7.3.3.1 and their listings:
1. Throughout all spaces within a smoke compartment containing patient sleeping

units in Group I-2 in accordance with the SBC 201.

2. Dwelling units and sleeping units in Group R and I-1 occupancies.

3. Light-hazard occupancies as defined in NFPA 13.

**7.3.3.3 Obstructed locations.** Automatic sprinklers shall be installed with due regard to obstructions that will delay activation or obstruct the water distribution pattern. Automatic sprinklers shall be installed in or under covered kiosks, displays, booths, concession stands, or equipment that exceeds 1.2 m in width. Not less than a 0.9 m clearance shall be maintained between automatic sprinklers and the top of piles of combustible fibers.

**Exception:** Kitchen equipment under exhaust hoods protected with a fire-extinguishing system in accordance with Section 7.4.

**7.3.3.4 Actuation.** Automatic sprinkler systems shall be automatically actuated unless specifically provided for in these code requirements.

**7.3.3.5 Water supplies.** Water supplies for automatic sprinkler systems shall comply with this section and the standards referenced in Section 7.3.3.1. The potable water supply shall be protected against backflow in accordance with the requirements of this section and the SBC 701.

**7.3.3.5.1 Domestic services.** Where the domestic service provides the water supply for the automatic sprinkler system, the supply shall be in accordance with this section.

**7.3.3.5.1.1 Limited area sprinkler systems.** Limited area sprinkler systems serving fewer than 20 sprinklers on any single connection are permitted to be connected to the domestic service where a wet automatic standpipe is not available. Limited area sprinkler systems connected to domestic water supplies shall comply with each of the following requirements:

1. Valves shall not be installed between the domestic water riser control valve and the sprinklers.

**Exception:** An approved indicating control valve supervised in the open position in accordance with Section 7.3.4.

2. The domestic service shall be capable of supplying the simultaneous domestic demand and the sprinkler demand required to be hydraulically calculated by NFPA 13, NFPA 13R or NFPA 13D.

**7.3.3.5.1.2 Residential combination services.** A single combination water supply shall be permitted provided that the domestic demand is added to the sprinkler demand as required by NFPA 13R.

**7.3.3.5.2 Secondary water supply.** A secondary on-site water supply equal to the hydraulically calculated sprinkler demand, including the hose stream requirement, shall be provided for high-rise buildings in Seismic Design Category C, D, E or F as determined by the SBC 201. The secondary water supply shall have a duration not less than 30 minutes as determined by the occupancy hazard classification in accordance with NFPA 13.

**Exception:** Existing buildings.

**7.3.3.6 Hose threads.** Fire hose threads used in connection with automatic sprinkler systems shall be approved and shall be compatible with Civil Defence hose threads.

**7.3.3.7 Civil Defence connections.** The location of Civil Defence connections shall be approved by the Building official.

**7.3.4 Sprinkler system monitoring and alarms.** All valves controlling the water supply for automatic sprinkler systems, pumps, tanks, water levels and temperatures, critical air pressures, and water-flow switches on all sprinkler systems shall be electrically supervised.

**Exceptions:**

1. Automatic sprinkler systems protecting one- and two-family dwellings.
2. Limited area systems serving fewer than 20 sprinklers.
3. Automatic sprinkler systems installed in accordance with NFPA 13R where a common supply main is used to supply both domestic water and the automatic sprinkler system, and a separate shutoff valve for the automatic sprinkler system is not provided.
4. Jockey pumps control valves that are sealed or locked in the open position.
5. Control valves to commercial kitchen hoods, paint spray booths or dip tanks that are sealed or locked in the open position.
6. Valves controlling the fuel supply to fire pump engines that are sealed or locked in the open position.
7. Trim valves to pressure switches in dry, preaction and deluge sprinkler systems that are sealed or locked in the open position.

**7.3.4.1 Signals.** Alarm, supervisory and trouble signals shall be distinctly different and shall be automatically transmitted to an approved central station, remote supervising station or proprietary supervising station as defined in NFPA 72 or, when approved by the Building official, shall sound an audible signal at a constantly attended location.

**Exceptions:**

1. Underground key or hub valves in roadway boxes provided by the municipality or public utility are not required to be monitored.
2. Backflow prevention device test valves, located in limited area sprinkler system supply piping, shall be locked in the open position. In occupancies required to be equipped with a fire alarm system, the backflow preventer valves shall be electrically supervised by a tamper switch installed in accordance with NFPA 72 and separately annunciated.

**7.3.4.2 Alarms.** Approved audible devices shall be connected to every automatic sprinkler system. Such sprinkler water-flow alarm devices shall be activated by water flow equivalent to the flow of a single sprinkler of the smallest orifice size installed in the system. Alarm devices shall be provided on the exterior of the building in an approved location. Where a fire alarm system is installed, actuation of the automatic sprinkler system shall actuate the building fire alarm system.

**7.3.4.3 Floor control valves.** Approved supervised indicating control valves shall be provided at the point of connection to the riser on each floor in high-rise buildings.

**7.3.5 Testing and maintenance.** Sprinkler systems shall be tested and maintained in accordance with Section 7.1.

**7.3.6 Existing buildings.** The provisions of this section are intended to provide a reasonable degree of safety in existing structures not complying with the minimum requirements of the SBC 201 by requiring installation of an automatic fire-extinguishing system.

**7.3.6.1 Pyroxylin plastics.** All structures occupied for the manufacture or storage of articles of cellulose nitrate (pyroxylin) plastic shall be equipped with an approved automatic fire-extinguishing system. Vaults located within buildings for the storage of raw pyroxylin shall be protected with an approved automatic sprinkler system capable of discharging 68 L/min/m<sup>2</sup> over the area of the vault.

## SECTION 7.4

### ALTERNATIVE AUTOMATIC FIRE-EXTINGUISHING SYSTEMS

- 7.4.1 General.** Automatic fire-extinguishing systems, other than automatic sprinkler systems, shall be designed, installed, inspected, tested and maintained in accordance with the provisions of this section and the applicable referenced standards.
- 7.4.2 Where required.** Automatic fire-extinguishing systems installed as an alternative to the required automatic sprinkler systems of Section 7.3 shall be approved by the Building official. Automatic fire-extinguishing systems shall not be considered alternatives for the purposes of exceptions or reductions permitted by other requirements of these code requirements.
- 7.4.2.1 Hood system suppression.** Each required commercial kitchen exhaust hood and duct system required by Section 4.10 to have a Type I hood shall be protected with an approved automatic fire-extinguishing system installed in accordance with these code requirements.
- 7.4.3 Installation.** Automatic fire-extinguishing systems shall be installed in accordance with this section.
- 7.4.3.1 Electrical wiring.** Electrical wiring shall be in accordance with the SBC 401.
- 7.4.3.2 Actuation.** Automatic fire-extinguishing systems shall be automatically actuated and provided with a manual means of actuation in accordance with Section 7.4.11.1.
- 7.4.3.3 System interlocking.** Automatic equipment interlocks with fuel shutoffs, ventilation controls, door closers, window shutters, conveyor openings, smoke and heat vents, and other features necessary for proper operation of the fire-extinguishing system shall be provided as required by the design and installation standard utilized for the hazard.
- 7.4.3.4 Alarms and warning signs.** Where alarms are required to indicate the operation of automatic fire-extinguishing systems, distinctive audible, visible alarms and warning signs shall be provided to warn of pending agent discharge. Where exposure to automatic-extinguishing agents poses a hazard to persons and a delay is required to ensure the evacuation of occupants before agent discharge, a separate warning signal shall be provided to alert occupants once agent discharge has begun. Audible signals shall be in accordance with Section 7.7.10.2.
- 7.4.3.5 Monitoring.** Where a building fire alarm system is installed, automatic fire-extinguishing systems shall be monitored by the building fire alarm system in accordance with NFPA 72.
- 7.4.4 Inspection and testing.** Automatic fire-extinguishing systems shall be inspected and tested in accordance with the provisions of this section prior to acceptance.
- 7.4.4.1 Inspection.** Prior to conducting final acceptance tests, the following items shall be inspected:
1. Hazard specification for consistency with design hazard.
  2. Type, location and spacing of automatic and manual-initiating devices.
  3. Size, placement and position of nozzles or discharge orifices.
  4. Location and identification of audible and visible alarm devices.
  5. Identification of devices with proper designations.
  6. Operating instructions.
- 7.4.4.2 Alarm testing.** Notification appliances, connections to fire alarm systems, and connections to approved supervising stations shall be tested in accordance with

this section and Section 7.7 to verify proper operation.

- 7.4.4.2.1 **Audible and visible signals.** The audibility and visibility of notification appliances signaling agent discharge or system operation, where required, shall be verified.
- 7.4.4.3 **Monitor testing.** Connections to protected premises and supervising station fire alarm systems shall be tested to verify proper identification and retransmission of alarms from automatic fire-extinguishing systems.
- 7.4.5 **Wet-chemical systems.** Wet-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 17A and their listing.
- 7.4.5.1 **System test.** Systems shall be inspected and tested for proper operation at 6 months intervals. Tests shall include a check of the detection system, alarms and releasing devices, including manual stations and other associated equipment. Extinguishing system units shall be weighed and the required amount of agent verified. Stored pressure-type units shall be checked for the required pressure. The cartridge of cartridge-operated units shall be weighed and replaced at intervals indicated by the manufacturer.
- 7.4.5.2 **Fusible link maintenance.** Fixed temperature-sensing elements shall be maintained to ensure proper operation of the system.
- 7.4.6 **Dry-chemical systems.** Dry-chemical extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 17 and their listing.
- 7.4.6.1 **System test.** Systems shall be inspected and tested for proper operation at 6 months intervals. Tests shall include a check of the detection system, alarms and releasing devices, including manual stations and other associated equipment. Extinguishing system units shall be weighed, and the required amount of agent verified. Stored pressure-type units shall be checked for the required pressure. The cartridge of cartridge-operated units shall be weighed and replaced at intervals indicated by the manufacturer.
- 7.4.6.2 **Fusible link maintenance.** Fixed temperature-sensing elements shall be maintained to ensure proper operation of the system.
- 7.4.7 **Foam systems.** Foam-extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 11, NFPA 11A and NFPA 16 and their listing.
- 7.4.7.1 **System test.** Foam-extinguishing systems shall be inspected and tested at intervals in accordance with NFPA 25.
- 7.4.8 **Carbon dioxide systems.** Carbon dioxide extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 12 and their listing.
- 7.4.8.1 **System test.** Systems shall be inspected and tested for proper operation at 12 months intervals.
- 7.4.8.2 **High-pressure cylinders.** High-pressure cylinders shall be weighed and the date of the last hydrostatic test shall be verified at 6 months intervals. Where a container shows a loss in original content of more than 10 percent, the cylinder shall be refilled or replaced.
- 7.4.8.3 **Low-pressure containers.** The liquid-level gauges of low-pressure containers shall be observed at one-week intervals. Where a container shows a content loss of more than 10 percent, the container shall be refilled to maintain the minimum gas

requirements.

- 7.4.8.4 **System hoses.** System hoses shall be examined at 12 months intervals for damage. Damaged hoses shall be replaced or tested. At five-year intervals, all hoses shall be tested.
- 7.4.8.4.1 **Test procedure.** Hoses shall be tested at not less than 17,238 kPa for high-pressure systems and at not less than 6,206 kPa for low-pressure systems.
- 7.4.8.5 **Auxiliary equipment.** Auxiliary and supplementary components, such as switches, door and window releases, interconnected valves, damper releases and supplementary alarms, shall be manually operated at 12 months intervals to ensure that such components are in proper operating condition.
- 7.4.9 **Halon systems.** Halogenated extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 12A and their listing.
- 7.4.9.1 **System test.** Systems shall be inspected and tested for proper operation at 12 months intervals.
- 7.4.9.2 **Containers.** The extinguishing agent quantity and pressure of containers shall be checked at 6 months intervals. Where a container shows a loss in original weight of more than 5 percent or a loss in original pressure (adjusted for temperature) of more than 10 percent, the container shall be refilled or replaced. The weight and pressure of the container shall be recorded on a tag attached to the container.
- 7.4.9.3 **System hoses.** System hoses shall be examined at 12 months intervals for damage. Damaged hoses shall be replaced or tested. At 5 years intervals, all hoses shall be tested.
- 7.4.9.3.1 **Test procedure.** For Halon 1301 systems, hoses shall be tested at not less than 10,343 kPa for 4,137 kPa charging pressure systems and not less than 6,206 kPa for 2,482 kPa charging pressure systems. For Halon 1211 hand-hose line systems, hoses shall be tested at 17,238 kPa for high-pressure systems and 6,206 kPa for low-pressure systems.
- 7.4.9.4 **Auxiliary equipment.** Auxiliary and supplementary components, such as switches, door and window releases, interconnected valves, damper releases and supplementary alarms, shall be manually operated at 12 months intervals to ensure such components are in proper operating condition.
- 7.4.10 **Clean-agent systems.** Clean-agent fire-extinguishing systems shall be installed, maintained, periodically inspected and tested in accordance with NFPA 2001 and their listing.
- 7.4.10.1 **System test.** Systems shall be inspected and tested for proper operation at 12 months intervals.
- 7.4.10.2 **Containers.** The extinguishing agent quantity and pressure of the containers shall be checked at 6 months intervals. Where a container shows a loss in original weight of more than 5 percent or a loss in original pressure, adjusted for temperature, of more than 10 percent, the container shall be refilled or replaced. The weight and pressure of the container shall be recorded on a tag attached to the container.
- 7.4.10.3 **System hoses.** System hoses shall be examined at 12 months intervals for damage. Damaged hoses shall be replaced or tested. All hoses shall be tested at 5-year intervals.
- 7.4.11 **Commercial cooking systems.** The automatic fire-extinguishing system for commercial cooking systems shall be of a type recognized for protection of commercial cooking equipment and exhaust systems of the type and arrangement protected. Preengineered automatic dry and wet-chemical extinguishing systems

shall be tested in accordance with UL 300 and listed and labeled for the intended application. Other types of automatic fire-extinguishing systems shall be listed and labeled for specific use as protection for commercial cooking operations. The system shall be installed in accordance with these code requirements, its listing and the manufacturer's installation instructions. Automatic fire-extinguishing systems of the following types shall be installed in accordance with the referenced standard indicated, as follows:

1. Carbon dioxide extinguishing systems, NFPA 12.
2. Automatic sprinkler systems, NFPA 13.
3. Foam-water sprinkler system or foam-water spray systems, NFPA 16.
4. Dry-chemical extinguishing systems, NFPA 17.
5. Wet-chemical extinguishing systems, NFPA 17A.

**Exception:** Factory-built commercial cooking recirculating systems that are tested in accordance with UL 197 and listed, labeled and installed in accordance with SBC 501.

- 7.4.11.1 Manual system operation.** A manual actuation device shall be located at or near a means of egress from the cooking area, a minimum of 3 m and a maximum of 6.1 m from the kitchen exhaust system. The manual actuation device shall be located a minimum of 1.2 m and a maximum of 1.5 m above the floor. The manual actuation shall require a maximum force of 178 N and a maximum movement of 350 mm to actuate the fire suppression system.

**Exception:** Automatic sprinkler systems shall not be required to be equipped with manual actuation means.

- 7.4.11.2 System interconnection.** The actuation of the fire suppression system shall automatically shut down the fuel or electrical power supply to the cooking equipment. The fuel and electrical supply reset shall be manual.

- 7.4.11.3 Carbon dioxide systems.** When carbon dioxide systems are used, there shall be a nozzle at the top of the ventilating duct. Additional nozzles that are symmetrically arranged to give uniform distribution shall be installed within vertical ducts exceeding 6.1 m and horizontal ducts exceeding 15.2 m. Dampers shall be installed at either the top or the bottom of the duct and shall be arranged to operate automatically upon activation of the fire-extinguishing system. When the damper is installed at the top of the duct, the top nozzle shall be immediately below the damper. Automatic carbon dioxide fire-extinguishing systems shall be sufficiently sized to protect all hazards venting through a common duct simultaneously.

- 7.4.11.3.1 Ventilation system.** Commercial-type cooking equipment protected by an automatic carbon dioxide extinguishing system shall be arranged to shutoff the ventilation system upon activation.

- 7.4.11.4 Special provisions for automatic sprinkler systems.** Automatic sprinkler systems protecting commercial-type cooking equipment shall be supplied from a separate, readily accessible, indicating-type control valve that is identified.

- 7.4.11.4.1 Listed sprinklers.** Sprinklers used for the protection of fryers shall be listed for that application and installed in accordance with their listing.

- 7.4.11.5 Commercial cooking equipment.** Portable fire extinguishers shall be provided within a 9.1 m travel distance of commercial-type cooking equipment. Cooking equipment involving vegetable or animal oils and fats shall be protected by a Class K rated portable extinguisher.

- 7.4.11.6 Operations and maintenance.** Commercial cooking systems shall be operated and maintained in accordance with this section.

- 7.4.11.6.1 Ventilation system.** The ventilation system in connection with hoods shall be operated at the required rate of air movement, and classified grease filters shall be in place when equipment under a kitchen grease hood is used.



- 7.4.11.6.2 Grease extractors.** Where grease extractors are installed, they shall be operated when the commercial-type cooking equipment is used.
- 7.4.11.6.3 Cleaning.** Hoods, grease-removal devices, fans, ducts and other appurtenances shall be cleaned at intervals necessary to prevent the accumulation of grease. Cleanings shall be recorded, and records shall state the extent, time and date of cleaning. Such records shall be maintained on the premises.
- 7.4.11.6.4 Extinguishing system service.** Automatic fire-extinguishing systems shall be serviced at least every 6 months and after activation of the system. Inspection shall be by qualified individuals, and a certificate of inspection shall be forwarded to the Building official upon completion.
- 7.4.11.6.5 Fusible link and sprinkler head replacement.** Fusible links and automatic sprinkler heads shall be replaced at least annually, and other protection devices shall be serviced or replaced in accordance with the manufacturer's instructions.  
**Exception:** Frangible bulbs are not required to be replaced annually.

## SECTION 7.5 STANDPIPE SYSTEMS

- 7.5.1 General.** Standpipe systems shall be provided in new buildings and structures in accordance with this section. Fire hose threads used in connection with standpipe systems shall be approved and shall be compatible with Civil Defence hose threads. The location of Civil Defence hose connections shall be approved. In buildings used for high-piled combustible storage, fire protection shall be in accordance with Chapter 21.
- 7.5.2 Installation standards.** Standpipe systems shall be installed in accordance with this section and NFPA 14.
- 7.5.3 Required installations.** Standpipe systems shall be installed where required by Sections 7.5.3.1 through 7.5.3.6 and in the locations indicated in Sections 7.5.4, 7.5.5 and 7.5.6. Standpipe systems are permitted to be combined with automatic sprinkler systems.  
**Exception:** Standpipe systems are not required in Group R-3 occupancies.
- 7.5.3.1 Building height.** Class III standpipe systems shall be installed throughout buildings where the floor level of the highest story is located more than 9.1 m above the lowest level of the Civil Defence vehicle access, or where the floor level of the lowest story is located more than 9.1 m below the highest level of Civil Defence vehicle access.  
**Exceptions:**
  1. Class I standpipes are allowed in buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.
  2. Class I manual standpipes are allowed in open parking garages where the highest floor is located not more than 45.7 m above the lowest level of Civil Defence vehicle access.
  3. Class I manual dry standpipes are allowed in open parking garages that are subject to freezing temperatures, provided that the hose connections are located as required for Class II standpipes in accordance with Section 7.5.5.
  4. Class I standpipes are allowed in basements equipped throughout with an automatic sprinkler system.
- 7.5.3.2 Group A.** Class I automatic wet standpipes shall be provided in nonsprinklered Group A buildings having an occupant load exceeding 1,000 persons.

**Exceptions:**

1. Open-air-seating spaces without enclosed spaces.
2. Class I automatic dry and semiautomatic dry standpipes or manual wet standpipes are allowed in buildings where the highest floor surface used for human occupancy is 22.9 m or less above the lowest level of Civil Defence vehicle access.

**7.5.3.3 Covered mall buildings.** A covered mall building shall be equipped throughout with a standpipe system where required by Section 7.5.3. Covered mall buildings not required to be equipped with a standpipe system by Section 7.5.3 shall be equipped with Class I hose connections connected to a system sized to deliver 946.3 L/min at the most hydraulically remote outlet. Hose connections shall be provided at each of the following locations:

1. Within the mall at the entrance to each exit passageway or corridor.
2. At each floor-level landing within enclosed stairways opening directly on the mall.
3. At exterior public entrances to the mall.

**7.5.3.4 Stages.** Stages greater than 93 m<sup>2</sup> shall be equipped with a Class III wet standpipe system with 40 mm and 65 mm hose connections on each side of the stage.

**Exception:** Where the building or area is equipped throughout with an automatic sprinkler system, the hose connections are allowed to be supplied from the automatic sprinkler system and shall have a flow rate of not less than that required by NFPA 14 for Class III standpipes.

**7.5.3.4.1 Hose and cabinet.** The 40 mm hose connections shall be equipped with sufficient lengths of 40 mm hose to provide fire protection for the stage area. Hose connections shall be equipped with an approved adjustable fog nozzle and be mounted in a cabinet or on a rack.

**7.5.3.5 Underground buildings.** Underground buildings shall be equipped throughout with a Class I automatic wet or manual wet standpipe system.

**7.5.3.6 Helistops and heliports.** Buildings with a helistop or heliport that are equipped with a standpipe shall extend the standpipe to the roof level on which the helistop or heliport is located in accordance with Section 11.7.5.

**7.5.4 Location of Class I standpipe hose connections.** Class I standpipe hose connections shall be provided in all of the following locations:

1. In every required stairway, a hose connection shall be provided for each floor level above or below grade. Hose connections shall be located at an intermediate floor level landing between floors, unless otherwise approved by the Building official.
2. On each side of the wall adjacent to the exit opening of a horizontal exit.
3. In every exit passageway at the entrance from the exit passageway to other areas of a building.
4. In covered mall buildings, adjacent to each exterior public entrance to the mall and adjacent to each entrance from an exit passageway or exit corridor to the mall.
5. Where the roof has a slope less than four units vertical in 12 units horizontal (33.3 percent slope), each standpipe shall be provided with a hose connection located either on the roof or at the highest landing of stairways with stair access to the roof. An additional hose connection shall be provided at the top of the most hydraulically remote standpipe for testing purposes.
6. Where the most remote portion of a nonsprinklered floor or story is more than 45.7 m from a hose connection or the most remote portion of a sprinklered floor or story is more than 61 m from a hose connection, the Building official

is authorized to require that additional hose connections be provided in approved locations.

- 7.5.4.1 Protection.** Risers and laterals of Class I standpipe systems not located within an enclosed stairway or pressurized enclosure shall be protected by a degree of fire resistance equal to that required for vertical enclosures in the building in which they are located.
- Exception:** In buildings equipped throughout with an approved automatic sprinkler system, laterals that are not located within an enclosed stairway or pressurized enclosure are not required to be enclosed within fire-resistance-rated construction.
- 7.5.4.2 Interconnection.** In buildings where more than one standpipe is provided, the standpipes shall be interconnected in accordance with NFPA 14.
- 7.5.5 Location of Class II standpipe hose connections.** Class II standpipe hose connections shall be accessible and shall be located so that all portions of the building are within 9.1 m of a nozzle attached to 30.5 m of hose.
- 7.5.5.1 Groups A-1 and A-2.** In Group A-1 and A-2 occupancies with occupant loads of more than 1,000, hose connections shall be located on each side of any stage, on each side of the rear of the auditorium, on each side of the balcony, and on each tier of dressing rooms.
- 7.5.5.2 Protection.** Fire-resistance-rated protection of risers and laterals of Class II standpipe systems is not required.
- 7.5.5.3 Class II system 25 mm hose.** A minimum 25 mm hose shall be allowed to be used for hose stations in light-hazard occupancies where investigated and listed for this service and where approved by the Building official.
- 7.5.6 Location of Class III standpipe hose connections.** Class III standpipe systems shall have hose connections located as required for Class I standpipes in Section 7.5.4 and shall have Class II hose connections as required in Section 7.5.5.
- 7.5.6.1 Protection.** Risers and laterals of Class III standpipe systems shall be protected as required for Class I systems in accordance with Section 7.5.4.1.
- 7.5.6.2 Interconnection.** In buildings where more than one Class III standpipe is provided, the standpipes shall be interconnected at the bottom.
- 7.5.7 Cabinets.** Cabinets containing fire-fighting equipment, such as standpipes, fire hose, fire extinguishers or Civil Defence valves, shall not be blocked from use or obscured from view.
- 7.5.7.1 Cabinet equipment identification.** Cabinets shall be identified in an approved manner by a permanently attached sign with letters not less than 51 mm high in a color that contrasts with the background color, indicating the equipment contained therein.
- Exceptions:**
1. Doors not large enough to accommodate a written sign shall be marked with a permanently attached pictogram of the equipment contained therein.
  2. Doors that have either an approved visual identification clear glass panel or a complete glass door panel are not required to be marked.
- 7.5.7.2 Locking cabinet doors.** Cabinets shall be unlocked.
- Exceptions:**
1. Visual identification panels of glass or other approved transparent frangible material that is easily broken and allows access.
  2. Approved locking arrangements.
  3. Use Group I-3.

- 7.5.8 Dry standpipes.** Dry standpipes shall not be installed.  
**Exception:** Where subject to freezing and in accordance with NFPA 14.
- 7.5.9 Valve supervision.** Valves controlling water supplies shall be supervised in the open position so that a change in the normal position of the valve will generate a supervisory signal at the supervising station required by Section 7.3.4. Where a fire alarm system is provided, a signal shall also be transmitted to the control unit.  
**Exceptions:**
1. Valves to underground key or hub valves in roadway boxes provided by the municipality or public utility do not require supervision.
  2. Valves locked in the normal position and inspected as provided in these code requirements in buildings not equipped with a fire alarm system.
- 7.5.10 During construction.** Standpipe systems required during construction and demolition operations shall be provided in accordance with Section 10.13.
- 7.5.11 Existing buildings.** Existing structures with occupied floors located more than 15.2 m above or below the lowest level of Civil Defence access shall be equipped with standpipes installed in accordance with Section 7.5. The standpipes shall have an approved Civil Defence connection with hose connections at each floor level above or below the lowest level of Civil Defence access. The Building official is authorized to approve the installation of manual standpipe systems to achieve compliance with this section where the responding Civil Defence is capable of providing the required hose flow at the highest standpipe outlet.

## SECTION 7.6 PORTABLE FIRE EXTINGUISHERS

- 7.6.1 Where required.** Portable fire extinguishers shall be installed in the following locations.
1. In all Group A, B, E, F, H, I, M, R-1, R-2, R-4 and S occupancies.  
**Exception:** In all Group A, B and E occupancies equipped throughout with quick-response sprinklers, fire extinguishers shall be required only in special-hazard areas.
  2. Within 9.1 m of commercial cooking equipment.
  3. In areas where flammable or combustible liquids are stored, used or dispensed.
  4. On each floor of structures under construction, except Group R-3 occupancies, in accordance with Section 10.15.1.
  5. Where required by the sections indicated in Table 7.6.1.
  6. Special-hazard areas, including but not limited to laboratories, computer rooms and generator rooms, where required by the Building official.
- 7.6.2 General requirements.** Fire extinguishers shall be selected, installed and maintained in accordance with this section and NFPA 10.  
**Exception:** The travel distance to reach an extinguisher shall not apply to the spectator seating portions of Group A-5 occupancies.
- 7.6.3 Size and distribution.** For occupancies that involve primarily Class A fire hazards, the minimum sizes and distribution shall comply with Table 7.6.3(1). Fire extinguishers for occupancies involving flammable or combustible liquids with depths of less than or equal 6.35 mm shall be selected and placed in accordance

with Table 7.6.3(2). Fire extinguishers for occupancies involving flammable or combustible liquids with a depth of greater than 6.35 mm or involving combustible metals shall be selected and placed in accordance with NFPA 10. Extinguishers for Class C fire hazards shall be selected and placed on the basis of the anticipated Class A or Class B hazard.

- 7.6.4 Cooking grease fires.** Fire extinguishers provided for the protection of cooking grease fires shall be of an approved type compatible with the automatic fire-extinguishing system agent and in accordance with Section 7.4.11.5.
- 7.6.5 Conspicuous location.** Extinguishers shall be located in conspicuous locations where they will be readily accessible and immediately available for use. These locations shall be along normal paths of travel, unless the Building official determines that the hazard posed indicates the need for placement away from normal paths of travel.
- 7.6.6 Unobstructed and unobscured.** Fire extinguishers shall not be obstructed or obscured from view. In rooms or areas in which visual obstruction cannot be completely avoided, means shall be provided to indicate the locations of extinguishers.
- 7.6.7 Hangers and brackets.** Hand-held portable fire extinguishers, not housed in cabinets, shall be installed on the hangers or brackets supplied. Hangers or brackets shall be securely anchored to the mounting surface in accordance with the manufacturer's installation instructions.
- 7.6.8 Cabinets.** Cabinets used to house fire extinguishers shall not be locked.
- Exceptions:**
1. Where fire extinguishers subject to malicious use or damage are provided with a means of ready access.
  2. In Group I-3 occupancies and in mental health areas in Group I-2 occupancies, access to portable fire extinguishers shall be permitted to be locked or to be located in staff locations provided the staff has keys.

**TABLE 7.6.1**  
**ADDITIONAL REQUIRED PORTABLE FIRE EXTINGUISHERS**

SECTION	SUBJECT
2.3 (SBC 201)	Asphalt kettles
2.7 (SBC 201)	Open burning
2.8 (SBC 201)	Open flames
2.9 (SBC 201)	Powered industrial trucks
11.5.2	Aircraft towing vehicles
11.5.3	Aircraft welding apparatus
11.5.4	Aircraft fuel-servicing tank vehicles
11.5.5	Aircraft hydrant fuel-servicing vehicles
11.5.6	Aircraft fuel-dispensing stations
11.7.7	Heliports and helistops
13.8.4	Dry cleaning plants
10.15.1	Buildings under construction or demolition

(Continued)

**TABLE 7.6.1 (Continued)**  
**ADDITIONAL REQUIRED PORTABLE FIRE EXTINGUISHERS**

<b>SECTION</b>	<b>SUBJECT</b>
10.17.3	Roofing operations
12.4.6.4	Spray-finishing operations
12.5.5	Dip-tank operations
17.4.2	Lumberyards/woodworking facilities
17.8.8	Recycling facilities
17.9.5	Exterior lumber storage
18.3.5	Organic-coating areas
19.6.3	Industrial ovens
20.5.5	Motor fuel-dispensing facilities
20.10.6.4	Marine motor fuel-dispensing facilities
20.11.6	Repair garages
21.6.1	Rack storage
22.4.12	Tents, canopies and membrane structures
23.8.2	Tire rebuilding/storage
24.4.2.6	Welding and other hot work
27.3.6	Combustible fibers
31.8.11	Fireworks
32.3.2.1	Flammable and combustible liquids, general
32.4.3.3.1	Indoor storage of flammable and combustible liquids
32.4.3.7.5.2	Liquid storage rooms for flammable and combustible liquids
32.5.4.9	Solvent distillation units
32.6.2.7	Farms and construction sites—flammable and combustible liquids storage
32.6.4.10.1	Bulk plants and terminals for flammable and combustible liquids
32.6.5.4.5	Commercial, industrial, governmental or manufacturing establishments—fuel dispensing
32.6.6.4	Tank vehicles for flammable and combustible liquids
34.6.5.7	Flammable solids
36.8.2	LP-gas

**TABLE 7.6.3(1)**  
**FIRE EXTINGUISHERS FOR CLASS A FIRE HAZARDS**

	<b>LIGHT (Low) HAZARD OCCUPANCY</b>	<b>ORDINARY (Moderate) HAZARD OCCUPANCY</b>	<b>EXTRA (High) HAZARD OCCUPANCY</b>
Minimum Rated Single Extinguisher	2-A <sup>c</sup>	2-A	4-A <sup>a</sup>
Maximum Floor Area Per Unit of A	278.7 m <sup>2</sup>	139.4 m <sup>2</sup>	93 m <sup>2</sup>
Maximum Floor Area For Extinguisher <sup>b</sup>	1,045 m <sup>2</sup>	1,045 m <sup>2</sup>	1,045 m <sup>2</sup>
Maximum Travel Distance to Extinguisher	22.9 m	22.9 m	22.9 m

a. Two 9.5 litre water-type extinguishers shall be deemed the equivalent of one 4-A rated extinguisher.

b. NFPA 10 Appendix E-3-3 provides more details concerning application of the maximum floor area criteria.

c. Two water-type extinguishers each with a 1-A rating shall be deemed the equivalent of one 2-A rated extinguisher for Light (Low) Hazard Occupancies.

**TABLE 7.6.3(2)**  
**FLAMMABLE OR COMBUSTIBLE LIQUIDS WITH DEPTHS OF LESS**  
**THAN OR EQUAL TO 6.4 MM**

<b>TYPE OF HAZARD</b>	<b>BASIC MINIMUM EXTINGUISHER RATING</b>	<b>MAXIMUM TRAVEL DISTANCE TO EXTINGUISHERS (meters)</b>
Light (Low)	5-B	9.1
	10-B	15.2
Ordinary (Moderate)	10-B	9.1
	20-B	15.2
Extra (High)	40-B	9.1
	80-B	15.2

**NOTE.** For requirements on water-soluble flammable liquids and alternative sizing criteria, see NFPA 10, Sections 3-3 and 3-4.

- 7.6.9 Height above floor.** Portable fire extinguishers having a gross weight not exceeding 18 kg shall be installed so that its top is not more than 1.5 m above the floor. Hand-held portable fire extinguishers having a gross weight exceeding 18 kg shall be installed so that its top is not more than 1.1 m above the floor. The clearance between the floor and the bottom of installed hand-held extinguishers shall not be less than 102 mm.
- 7.6.10 Wheeled units.** Wheeled fire extinguishers shall be conspicuously located in a designated location.

## **SECTION 7.7**

### **FIRE ALARM AND DETECTION SYSTEMS**

- 7.7.1 General.** This section covers the application, installation, performance and maintenance of fire alarm systems and their components in new and existing buildings and structures. The requirements of Section 7.7.2 are applicable to new buildings and structures. The requirements of Section 7.7.3 are applicable to existing buildings and structures.
- 7.7.1.1 Construction documents.** Construction documents for fire alarm systems shall be submitted for review and approval prior to system installation. Construction documents shall include, but not be limited to, all of the following:
1. A floor plan which indicates the use of all rooms.
  2. Locations of alarm-initiating and notification appliances.
  3. Alarm control and trouble signaling equipment.
  4. Annunciation.
  5. Power connection.
  6. Battery calculations.
  7. Conductor type and sizes.
  8. Voltage drop calculations.
  9. Manufacturers, model numbers and listing information for equipment, devices and materials.
  10. Details of ceiling height and construction.
  11. The interface of fire safety control functions.
- 7.7.1.2 Equipment.** Systems and their components shall be listed and approved for the purpose for which they are installed.
- 7.7.2 Where required – new buildings and structures.** An approved manual, automatic, or manual and automatic fire alarm system shall be provided in new

buildings and structures in accordance with Sections 7.7.2.1 through 7.7.2.23. Where automatic sprinkler protection installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 is provided and connected to the building fire alarm system, automatic heat detection required by this section shall not be required.

An approved automatic fire detection system shall be installed in accordance with the provisions of these code requirements and NFPA 72. Devices, combinations of devices, appliances and equipment shall comply with Section 7.7.1.2. The automatic fire detectors shall be smoke detectors, except that an approved alternative type of detector shall be installed in spaces such as boiler rooms where, during normal operation, products of combustion are present in sufficient quantity to actuate a smoke detector.

- 7.7.2.1 Group A.** A manual fire alarm system shall be installed in accordance with NFPA 72 in Group A occupancies having an occupant load of 300 or more. Portions of Group E occupancies occupied for assembly purposes shall be provided with a fire alarm system as required for the Group E occupancy.

**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

- 7.7.2.1.1 System initiation in Group A occupancies with an occupant load of 1,000 or more.** Activation of the fire alarm in Group A occupancies with an occupant load of 1,000 or more shall initiate a signal using an emergency voice/alarm communications system in accordance with NFPA 72.

**Exception:** Where approved, the prerecorded announcement is allowed to be manually deactivated for a period of time, not to exceed 3 minutes, for the sole purpose of allowing a live voice announcement from an approved, constantly attended location.

- 7.7.2.1.2 Emergency power.** Emergency voice/alarm communications systems shall be provided with an approved emergency power source.

- 7.7.2.2 Group B.** A manual fire alarm system shall be installed in Group B occupancies having an occupant load of 500 or more persons or more than 100 persons above or below the lowest level of exit discharge.

**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

- 7.7.2.3 Group E.** A manual fire alarm system shall be installed in Group E occupancies. When automatic sprinkler systems or smoke detectors are installed, such systems or detectors shall be connected to the building fire alarm system.

**Exceptions:**

1. Group E occupancies with an occupant load of less than 50.
2. Manual fire alarm boxes are not required in Group E occupancies where all the following apply:
  - 2.1 Interior corridors are protected by smoke detectors with alarm verification.
  - 2.2 Auditoriums, cafeterias, gymnasiums and the like are protected by heat detectors or other approved detection devices.
  - 2.3 Shops and laboratories involving dusts or vapors are protected by heat detectors or other approved detection devices.
  - 2.4 Off-premises monitoring is provided.
  - 2.5 The capability to activate the evacuation signal from a central point is provided.
  - 2.6 In buildings where normally occupied spaces are provided with a two-way communication system between such spaces and a constantly



attended receiving station from where a general evacuation alarm can be sounded, except in locations specifically designated by the Building official.

**7.7.2.4 Group F.** A manual fire alarm system shall be installed in Group F occupancies that are two or more stories in height and have an occupant load of 500 or more above or below the lowest level of exit discharge.

**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

**7.7.2.5 Group H.** A manual fire alarm system shall be installed in Group H-5 occupancies and in occupancies used for the manufacture of organic coatings. An automatic smoke detection system shall be installed for highly toxic gases, organic peroxides and oxidizers in accordance with Chapters 35, 37 and 38, respectively.

**7.7.2.6 Group I.** A manual fire alarm system and an automatic fire detection system shall be installed in Group I occupancies. An electrically supervised, automatic smoke detection system shall be provided in waiting areas that are open to corridors.

**Exception:** Manual fire alarm boxes in patient sleeping areas of Group I-1 and I-2 occupancies shall not be required at exits if located at all nurses' control stations or other constantly attended staff locations, provided such stations are visible and continuously accessible and that travel distances required in Section 7.7.4.1 are not exceeded.

**7.7.2.6.1 Group I-2.** Corridors in nursing homes (both intermediate care and skilled nursing facilities), detoxification facilities and spaces open to the corridors shall be equipped with an automatic fire detection system.

**Exceptions:**

1. Corridor smoke detection is not required in smoke compartments that contain patient sleeping rooms where patient sleeping units are provided with smoke detectors that comply with UL 268. Such detectors shall provide a visual display on the corridor side of each patient sleeping unit and shall provide an audible and visual alarm at the nursing station attending each unit.
2. Corridor smoke detection is not required in smoke compartments that contain patient sleeping rooms where patient sleeping unit doors are equipped with automatic door-closing devices with integral smoke detectors on the unit sides installed in accordance with their listing, provided that the integral detectors perform the required alerting function.

**7.7.2.6.2 Group I-3 occupancies.** Group I-3 occupancies shall be equipped with a manual and automatic fire alarm system installed for alerting staff.

**7.7.2.6.2.1 System initiation.** Actuation of an automatic fire-extinguishing system, a manual fire alarm box or a fire detector shall initiate an approved fire alarm signal which automatically notifies staff. Presignal systems shall not be used.

**7.7.2.6.2.2 Manual fire alarm boxes.** Manual fire alarm boxes are not required to be located in accordance with Section 7.7.4 where the fire alarm boxes are provided at staff-attended locations having direct supervision over areas where manual fire alarm boxes have been omitted.

Manual fire alarm boxes are allowed to be locked in areas occupied by detainees, provided that staff members are present within the subject area and have keys readily available to operate the manual fire alarm boxes.

**7.7.2.6.2.3 Smoke detectors.** An approved automatic smoke detection system shall be installed throughout resident housing areas, including sleeping areas and contiguous day rooms, group activity spaces and other common spaces normally accessible to residents.

**Exceptions:**

1. Other approved smoke-detection arrangements providing equivalent protection, including, but not limited to, placing detectors in exhaust ducts from cells or behind protective guards listed for the purpose, are allowed when necessary to prevent damage or tampering.
2. Sleeping units in Use Conditions 2 and 3.
3. Smoke detectors are not required in sleeping units with four or fewer occupants in smoke compartments that are equipped throughout with an approved automatic sprinkler system.

**7.7.2.7 Group M.** A manual fire alarm system shall be installed in Group M occupancies, other than covered mall buildings complying with Section 2.15 of the SBC 201, having an occupant load of 500 or more persons or more than 100 persons above or below the lowest level of exit discharge.

**Exception:** Manual fire alarm boxes are not required where the building is equipped throughout with an automatic sprinkler system and the alarm notification appliances will activate upon sprinkler water flow.

**7.7.2.7.1 Occupant notification.** During times that the building is occupied, in lieu of the automatic activation of alarm notification appliances, the manual fire alarm system shall be allowed to activate an alarm signal at a constantly attended location from which evacuation instructions shall be initiated over an emergency voice/alarm communication system installed in accordance with Section 7.7.2.12.2.

The emergency voice/alarm communication system shall be allowed to be used for other announcements provided the manual fire alarm use takes precedence over any other use.

**7.7.2.8 Group R-1.** Fire alarm systems shall be installed in Group R-1 occupancies as required in Sections 7.7.2.8.1 through 7.7.2.8.3.

**7.7.2.8.1 Manual fire alarm system.** A manual fire alarm system shall be installed in Group R-1 occupancies.

**Exceptions:**

1. A manual fire alarm system is not required in buildings not more than two stories in height where all individual guestrooms and contiguous attic and crawl spaces are separated from each other and public or common areas by at least 1 hour fire partitions and each individual guestroom has an exit directly to a public way, exit court or yard.
2. Manual fire alarm boxes are not required throughout the building when the following conditions are met:
  - 2.1 The building is equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2;
  - 2.2 The notification appliances will activate upon sprinkler water flow; and
  - 2.3 At least one manual fire alarm box is installed at an approved location.

**7.7.2.8.2 Automatic fire alarm system.** An automatic fire alarm system shall be installed throughout all interior corridors serving guestrooms.

**Exception:** An automatic fire detection system is not required in buildings that do not have interior corridors serving guestrooms and each guestroom has a means of egress door opening directly to an exterior exit access that leads directly to an exit.

**7.7.2.8.3 Smoke alarms.** Smoke alarms shall be installed as required by Section 7.7.2.10. In buildings that are not equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, the smoke alarms in guestrooms shall be connected to an emergency electrical system and shall be annunciated by guestroom at a constantly attended location from which the fire alarm system is capable of being manually activated.

**7.7.2.9 Group R-2.** A manual fire alarm system shall be installed in Group R-2 occupancies where:

1. Any dwelling unit or sleeping unit is located three or more stories above the lowest level of exit discharge;
2. Any dwelling unit or sleeping unit is located more than one story below the highest level of exit discharge of exits serving the dwelling unit or sleeping unit; or
3. The building contains more than 16 dwelling units or sleeping units.

**Exceptions:**

1. A fire alarm system is not required in buildings not more than two stories in height where all dwelling units or sleeping units and contiguous attic and crawl spaces are separated from each other and public or common areas by at least 1 hour fire partitions and each dwelling unit or sleeping unit has an exit directly to a public way, exit court or yard.
2. Manual fire alarm boxes are not required throughout the building when the following conditions are met:
  - 2.1 The building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or Section 7.3.3.1.2;
  - 2.2 The notification appliances will activate upon sprinkler flow; and
  - 2.3 At least one manual fire alarm box is installed at an approved location.
3. A fire alarm system is not required in buildings that do not have interior corridors serving dwelling units and are protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, provided that dwelling units either have a means of egress door opening directly to an exterior exit access that leads directly to the exits or are served by open-ended corridors designed in accordance with Section 8.22.6, Exception 4.

**7.7.2.10 Single and multiple-station smoke alarms.** Listed single and multiple-station smoke alarms shall be installed in accordance with the provisions of these code requirements and the household fire-warning equipment provisions of NFPA 72.

**7.7.2.10.1 Where required.** Single or multiple-station smoke alarms shall be installed in the locations described in Sections 7.7.2.10.1 through 7.7.2.10.1.4.

**7.7.2.10.1.1 Group R-1.** Single or multiple-station smoke alarms shall be installed in all of the following locations in Group R-1:

1. In sleeping areas.
2. In every room in the path of the means of egress from the sleeping area to the door leading from the sleeping unit.
3. In each story within the sleeping unit, including basements. For sleeping units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower level provided that the lower level is less than one full story below the upper level.

**7.7.2.10.1.2 Groups R-2, R-3, R-4 and I-1.** Single or multiple-station smoke alarms shall be installed and maintained in Groups R-2, R-3, R-4 and I-1 regardless of occupant load at all of the following locations:

1. On the ceiling or wall outside of each separate sleeping area in the immediate vicinity of bedrooms.
2. In each room used for sleeping purposes.
3. In each story within a dwelling unit, including basements but not including crawl spaces and uninhabitable attics. In dwelling units with split levels and without an intervening door between the adjacent levels, a smoke alarm installed on the upper level shall suffice for the adjacent lower level provided

that the lower level is less than one full story below the upper level.

- 7.7.2.10.1.3 Group I-1.** Single or multiple-station smoke alarms shall be installed and maintained in sleeping areas in occupancies in Group I-1. Single or multiple-station smoke alarms shall not be required where the building is equipped throughout with an automatic fire detection system in accordance with Section 7.7.2.6.
- 7.7.2.10.2 Power source.** In new construction, required smoke alarms shall receive their primary power from the building wiring where such wiring is served from a commercial source and shall be equipped with a battery backup. Smoke alarms shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting switch other than as required for overcurrent protection.  
**Exception:** Smoke alarms are not required to be equipped with battery backup in Group R-1 where they are connected to an emergency electrical system.
- 7.7.2.10.3 Interconnection.** Where more than one smoke alarm is required to be installed within an individual dwelling unit or sleeping unit in Group R-2, R-3 or R-4, or within an individual sleeping unit in Group R-1, the smoke alarms shall be interconnected in such a manner that the activation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.
- 7.7.2.10.4 Acceptance testing.** When the installation of the alarm devices is complete, each detector and inter-connecting wiring for multiple-station alarm devices shall be tested in accordance with the household fire warning equipment provisions of NFPA 72.
- 7.7.2.11 Special amusement buildings.** An approved automatic smoke detection system shall be provided in special amusement buildings in accordance with this section.  
**Exception:** In areas where ambient conditions will cause a smoke detection system to alarm, an approved alternative type of automatic detector shall be installed.
- 7.7.2.11.1 Alarm.** Activation of any single smoke detector, the automatic sprinkler system or any other automatic fire detection device shall immediately sound an alarm at the building at a constantly attended location from which emergency action can be initiated, including the capability of manual initiation of requirements in Section 7.7.2.11.2.
- 7.7.2.11.2 System response.** The activation of two or more smoke detectors, a single smoke detector with alarm verification, the automatic sprinkler system or other approved fire detection device shall automatically:
1. Cause illumination of the means of egress with light of not less than 1 foot-candle (11 lux) at the walking surface level;
  2. Stop any conflicting or confusing sounds and visual distractions; and
  3. Activate an approved directional exit marking that will become apparent in an emergency.
- Such system response shall also include activation of a prerecorded message, clearly audible throughout the special amusement building, instructing patrons to proceed to the nearest exit. Alarm signals used in conjunction with the prerecorded message shall produce a sound which is distinctive from other sounds used during normal operation.
- The wiring to the auxiliary devices and equipment used to accomplish the above fire safety functions shall be monitored for integrity in accordance with NFPA 72.
- 7.7.2.11.3 Emergency voice/alarm communication system.** An emergency voice/alarm communication system, which is also allowed to serve as a public address system, shall be installed in accordance with NFPA 72 and be audible throughout the entire special amusement building.

**7.7.2.12 High-rise buildings.** Buildings having floors used for human occupancy located more than 22.9 m above the lowest level of Civil Defence vehicle access shall be provided with an automatic fire alarm system and an emergency voice/alarm communication system in accordance with Section 7.7.2.12.2.

**Exceptions:**

1. Airport traffic control towers in accordance with Section 7.7.2.22 and the SBC 201.
2. Open parking garages in accordance with Section 2.19 of the SBC 201.
3. Buildings with an occupancy in Group A-5 in accordance with Section 2.3 of the SBC 201.
4. Low-hazard special occupancies in accordance with Section 3.3 of the SBC 201.
5. Buildings with an occupancy in Group H-1, H-2 or H-3 in accordance with Section 2.28 of the SBC 201.

**7.7.2.12.1 Automatic fire detection.** Smoke detectors shall be provided in accordance with this section. Smoke detectors shall be connected to an automatic fire alarm system. The activation of any detector required by this section shall operate the emergency voice/alarm communication system. Smoke detectors shall be located as follows:

1. In each mechanical equipment, electrical, transformer, telephone equipment or similar room which is not provided with sprinkler protection, elevator machine rooms, and in elevator lobbies.
2. In the main return air and exhaust air plenum of each air-conditioning system having a capacity greater than  $0.94 \text{ m}^3/\text{s}$ . Such detectors shall be located in a serviceable area downstream of the last duct inlet.
3. At each connection to a vertical duct or riser serving two or more stories from a return air duct or plenum of an air-conditioning system. In Group R-1 and R-2 occupancies, a listed smoke detector is allowed to be used in each return-air riser carrying not more than  $2.4 \text{ m}^3/\text{s}$  and serving not more than 10 air-inlet openings.

**7.7.2.12.2 Emergency voice/alarm communication system.** The operation of any automatic fire detector, sprinkler water-flow device or manual fire alarm box shall automatically sound an alert tone followed by voice instructions giving approved information and directions on a general or selective basis to the following terminal areas on a minimum of the alarming floor, the floor above, and the floor below in accordance with the building's fire safety and evacuation plans required by Section 5.4.

1. Elevator lobbies.
2. Corridors.
3. Rooms and tenant spaces exceeding  $93 \text{ m}^2$  in area.
4. Dwelling units and sleeping units in Group R-2 occupancies.
5. Sleeping units in Group R-1 occupancies.
6. Areas of refuge as defined in Section 8.2.

**Exception:** In Group I-1 and I-2 occupancies, the alarm shall sound in a constantly attended area and a general occupant notification shall be broadcast over the overhead page.

**7.7.2.12.2.1 Manual override.** A manual override for emergency voice communication shall be provided for all paging zones.

**7.7.2.12.2.2 Live voice messages.** The emergency voice/alarm communication system shall also have the capability to broadcast live voice messages through speakers located in elevators, exit stairways, and throughout a selected floor or floors.

**7.7.2.12.2.3 Standard.** The emergency voice/alarm communication system shall be designed and installed in accordance with NFPA 72.

- 7.7.2.12.3 Civil Defence communication system.** An approved two-way, Civil Defence communication system designed and installed in accordance with NFPA 72 shall be provided for Civil Defence use. It shall operate between a fire command center complying with Section 3.9 and elevators, elevator lobbies, emergency and standby power rooms, fire pump rooms, areas of refuge and inside enclosed exit stairways. The Civil Defence communication device shall be provided at each floor level within the enclosed exit stairway.
- Exception:** Civil Defence radio systems where approved by the Civil Defence.
- 7.7.2.13 Atriums connecting more than two stories.** A fire alarm system shall be installed in occupancies with an atrium that connects more than two stories. The system shall be activated in accordance with Section 7.7.7. Such occupancies in Group A, E or M shall be provided with an emergency voice/alarm communication system complying with the requirements of Section 7.7.2.12.2.
- 7.7.2.14 High-piled combustible storage areas.** An automatic fire detection system shall be installed throughout high-piled combustible storage areas where required by Section 21.6.5.
- 7.7.2.15 Delayed egress locks.** Where delayed egress locks are installed on means of egress doors in accordance with Section 8.8.1.8.6, an automatic smoke or heat detection system shall be installed as required by that section.
- 7.7.2.16 Aerosol storage uses.** Aerosol storage rooms and general-purpose warehouses containing aerosols shall be provided with an approved manual fire alarm system where required by these code requirements.
- 7.7.2.17 Lumber, plywood and veneer mills.** Lumber, plywood and veneer mills shall be provided with a manual fire alarm system.
- 7.7.2.18 Underground buildings with smoke exhaust systems.** Where a smoke exhaust system is installed in an underground building in accordance with the SBC 201, automatic fire detectors shall be provided in accordance with this section.
- 7.7.2.18.1 Smoke detectors.** A minimum of one smoke detector listed for the intended purpose shall be installed in the following areas:
1. Mechanical equipment, electrical, transformer, telephone equipment, elevator machine or similar rooms.
  2. Elevator lobbies.
  3. The main return and exhaust air plenum of each air-conditioning system serving more than one story and located in a serviceable area downstream of the last duct inlet.
  4. Each connection to a vertical duct or riser serving two or more floors from return air ducts or plenums of heating, ventilating and air-conditioning systems, except that in Group R occupancies, a listed smoke detector is allowed to be used in each return-air riser carrying not more than 2.4 m<sup>3</sup>/s and serving not more than 10 air inlet openings.
- 7.7.2.18.2 Alarm required.** Activation of the smoke exhaust system shall activate an audible alarm at a constantly attended location.
- 7.7.2.19 Underground buildings.** Where the lowest level of a structure is more than 18.3 m below the lowest level of exit discharge, the structure shall be equipped throughout with a manual fire alarm system, including an emergency voice/alarm communication system installed in accordance with Section 7.7.2.12.2.
- 7.7.2.19.1 Public address system.** Where a fire alarm system is not required by Section 7.7.2, a public address system shall be provided which shall be capable of transmitting voice communications to the highest level of exit discharge serving the underground portions of the structure and all levels below.
- 7.7.2.20 Covered mall buildings.** Covered mall buildings exceeding 4,645 m<sup>2</sup> in total floor area shall be provided with an emergency voice/alarm communication system. An

emergency voice/alarm communication system serving a mall, required or otherwise, shall be accessible to the Civil Defence. The system shall be provided in accordance with Section 7.7.2.12.2.

- 7.7.2.21 Residential aircraft hangars.** A minimum of one listed smoke alarm shall be installed within a residential aircraft hangar as defined in the SBC 201 and shall be interconnected into the residential smoke alarm or other sounding device to provide an alarm which will be audible in all sleeping areas of the dwelling.
- 7.7.2.22 Airport traffic control towers.** An automatic fire detection system shall be provided in airport traffic control towers.
- 7.7.2.23 Battery rooms.** An approved automatic smoke detection system shall be installed in areas containing stationary lead-acid battery systems having a liquid capacity of more than 189 L. The detection system shall be supervised by an approved central, proprietary, or remote station service or a local alarm which will sound an audible signal at a constantly attended location.
- 7.7.3 Where required—retroactive in existing buildings and structures.** An approved manual, automatic or manual and automatic fire alarm system shall be installed in existing buildings and structures in accordance with Sections 7.7.3.1 through 7.7.3.1.8. Where automatic sprinkler protection is provided in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 and connected to the building fire alarm system, automatic heat detection required by this section shall not be required. An approved automatic fire detection system shall be installed in accordance with the provisions of these code requirements and NFPA 72. Devices, combinations of devices, appliances and equipment shall be approved. The automatic fire detectors shall be smoke detectors, except an approved alternative type of detector shall be installed in spaces such as boiler rooms where, during normal operation, products of combustion are present in sufficient quantity to actuate a smoke detector.
- 7.7.3.1 Occupancy requirements.** A fire alarm system shall be installed in accordance with Sections 7.7.3.1.1 through 7.7.3.1.8.
- Exception:** Occupancies with an existing, previously approved fire alarm system.
- 7.7.3.1.1 Group E.** A fire alarm system shall be installed in existing Group E occupancies in accordance with Section 7.7.2.3.
- Exceptions:**
1. A building with a maximum area of 93 m<sup>2</sup> that contains a single classroom and is located no closer than 15.2 m from another building.
  2. Group E with an occupant load less than 50.
- 7.7.3.1.2 Group I-1.** A fire alarm system shall be installed in existing Group I-1 residential care/assisted living facilities.
- Exception:** Where each sleeping room has a means of egress door opening directly to an exterior egress balcony that leads directly to the exits in accordance with Section 8.13.5, and the building is not more than three stories in height.
- 7.7.3.1.3 Group I-2.** A fire alarm system shall be installed in existing Group I-2 occupancies in accordance with Section 7.7.2.6.
- 7.7.3.1.4 Group I-3.** A fire alarm system shall be installed in existing Group I-3 occupancies in accordance with Section 7.7.2.6.1.
- 7.7.3.1.5 Group R-1 hotels and motels.** A fire alarm system shall be installed in existing Group R-1 hotels and motels more than three stories or with more than 20 guestrooms.
- Exception:** Buildings less than two stories in height where all guestrooms, attics and crawl spaces are separated by 1 hour fire-resistance-rated construction and each guestroom has direct access to a public way, exit court or yard.

**7.7.3.1.6 Group R-1 boarding and rooming houses.** A fire alarm system shall be installed in existing Group R-1 boarding and rooming houses.

**Exception:** Buildings that have single-station smoke alarms meeting or exceeding the requirements of Section 7.7.2.10.1 and where the fire alarm system includes at least one manual fire alarm box per floor arranged to initiate the alarm.

**7.7.3.1.7 Group R-2.** A fire alarm system shall be installed in existing Group R-2 occupancies more than three stories in height or with more than 16 dwelling units or sleeping units.

**Exceptions:**

1. Where each living unit is separated from other contiguous living units by fire barriers having a fire-resistance rating of not less than 0.75 hour, and where each living unit has either its own independent exit or its own independent stairway or ramp discharging at grade.
2. A separate fire alarm system is not required in buildings that are equipped throughout with an approved supervised automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 and having a local alarm to notify all occupants.
3. A fire alarm system is not required in buildings that do not have interior corridors serving dwelling units and are protected by an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, provided that dwelling units either have a means of egress door opening directly to an exterior exit access that leads directly to the exits or are served by open-ended corridors designed in accordance with Section 8.22.6, Exception 4.

**7.7.3.1.8 Group R-4.** A fire alarm system shall be installed in existing Group R-4 residential care/assisted living facilities.

**Exceptions:**

1. Where there are interconnected smoke alarms meeting the requirements of Section 7.7.2.10 and there is at least one manual fire alarm box per floor arranged to sound continuously the smoke alarms.
2. Other manually activated, continuously sounding alarms approved by the Building official.

**7.7.3.2 Single and multiple-station smoke alarms.** Single and multiple-station smoke alarms shall be installed in existing Group R occupancies in accordance with Sections 7.7.3.2.1 through 7.7.3.2.3.

**7.7.3.2.1 General.** Existing Group R occupancies not already provided with single-station smoke alarms shall be provided with approved single-station smoke alarms. Installation shall be in accordance with Section 7.7.2.10, except as provided in Sections 7.7.3.2.2 and 7.7.3.2.3.

**7.7.3.2.2 Interconnection.** Where more than one smoke alarm is required to be installed within an individual dwelling unit in Group R-2, R-3 or R-4, or within an individual sleeping unit in Group R-1, the smoke alarms shall be interconnected in such a manner that the activation of one alarm will activate all of the alarms in the individual unit. The alarm shall be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

**Exceptions:**

1. Interconnection is not required in buildings that are not undergoing alterations, repairs or construction of any kind.
2. Smoke alarms in existing areas are not required to be interconnected where alterations or repairs do not result in the removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for interconnection without the



removal of interior finishes.

- 7.7.3.2.3 Power source.** In Group R occupancies, single-station smoke alarms shall receive their primary power from the building wiring provided that such wiring is served from a commercial source and shall be equipped with a battery backup. Smoke alarms shall emit a signal when the batteries are low. Wiring shall be permanent and without a disconnecting switch other than as required for overcurrent protection.

**Exception:** Smoke alarms are permitted to be solely battery operated: in existing buildings where no construction is taking place; in buildings that are not served from a commercial power source; and in existing areas of buildings undergoing alterations or repairs that do not result in the removal of interior walls or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available which could provide access for building wiring without the removal of interior finishes.

- 7.7.4 Manual fire alarm boxes.** Manual fire alarm boxes shall be installed in accordance with Sections 7.7.4.1 through 7.7.4.5.

- 7.7.4.1 Location.** Manual fire alarm boxes shall be located not more than 1.5 m from the entrance to each exit. Additional manual fire alarm boxes shall be located so that travel distance to the nearest box does not exceed 61 m.

**Exception:** Manual fire alarm boxes shall not be required in Group E occupancies where the building is equipped throughout with an approved automatic sprinkler system, the notification appliances will activate on sprinkler water flow and manual activation is provided from a normally occupied location.

- 7.7.4.2 Height.** The height of the manual fire alarm boxes shall be a minimum of 1,067 mm and a maximum of 1.2 m measured vertically, from the floor level to the activating handle or lever of the box.

- 7.7.4.3 Color.** Manual fire alarm boxes shall be red in color.

- 7.7.4.4 Signs.** Where fire alarm systems are not monitored by a supervising station, an approved permanent sign shall be installed adjacent to each manual fire alarm box that reads: WHEN ALARM SOUNDS – CALL FIRE DEPARTMENT.

**Exception:** Where the manufacturer has permanently provided this information on the manual fire alarm box.

- 7.7.4.5 Protective covers.** The Building official is authorized to require the installation of listed manual fire alarm box protective covers to prevent malicious false alarms or provide the manual fire alarm box with protection from physical damage. The protective cover shall be transparent or red in color with a transparent face to permit visibility of the manual fire alarm box. Each cover shall include proper operating instructions. A protective cover that emits a local alarm signal shall not be installed unless approved.

- 7.7.5 Power supply.** The primary and secondary power supply for the fire alarm system shall be provided in accordance with NFPA 72.

- 7.7.6 Wiring.** Wiring shall comply with the requirements of the SBC 401 and NFPA 72. Wireless protection systems utilizing radio-frequency transmitting devices shall comply with the special requirements for supervision of low-power wireless systems in NFPA 72.

- 7.7.7 Activation.** Where an alarm notification system is required by another section of these code requirements, it shall be activated by:

- 1.** Required automatic fire alarm system.

2. Sprinkler water-flow devices.
3. Required manual fire alarm boxes.

- 7.7.8 Presignal system.** Presignal systems shall not be installed unless approved by the Building official and the Civil Defence. Where a presignal system is installed, 24 hours personnel supervision shall be provided at a location approved by the Civil Defence, in order that the alarm signal can be actuated in the event of fire or other emergency.
- 7.7.9 Zones.** Each floor shall be zoned separately and a zone shall not exceed 2.1 m<sup>2</sup>. The length of any zone shall not exceed 91.4 m in any direction.  
**Exception:** Automatic sprinkler system zones shall not exceed the area permitted by NFPA 13.
- 7.7.9.1 Zoning indicator panel.** A zoning indicator panel and the associated controls shall be provided in an approved location. The visual zone indication shall lock in until the system is reset and shall not be canceled by the operation of an audible-alarm silencing switch.
- 7.7.9.2 High-rise buildings.** In buildings that have floors located more than 22.9 m above the lowest level of Civil Defence vehicle access that are occupied for human occupancy, a separate zone by floor shall be provided for all of the following types of alarm-initiating devices where provided:
1. Smoke detectors.
  2. Sprinkler water-flow devices.
  3. Manual fire alarm boxes.
  4. Other approved types of automatic fire detection devices or suppression systems.
- 7.7.10 Alarm notification appliances.** Alarm notification appliances shall be provided and shall be listed for their purpose.
- 7.7.10.1 Visible alarms.** Visible alarm notification appliances shall be provided in accordance with Sections 7.7.10.1.1 through 7.7.10.1.4.  
**Exceptions:**
1. Visible alarm notification appliances are not required in alterations, except where an existing fire alarm system is upgraded or replaced, or a new fire alarm system is installed.
  2. Visible alarm notification appliances shall not be required in exits as defined in Section 8.2.1.
- 7.7.10.1.1 Public and common areas.** Visible alarm notification appliances shall be provided in public areas and common areas.
- 7.7.10.1.2 Employee work areas.** Where employee work areas have audible alarm coverage, the wiring system shall be designed so that visible alarm notification appliances can be integrated into the alarm system.
- 7.7.10.1.3 Groups I-1 and R-1.** Group I-1 and R-1 sleeping units in accordance with Table 7.7.10.1.3 shall be provided with a visible alarm notification appliance, activated by both the in-room smoke alarm and the building fire alarm system.

**TABLE 7.7.10.1.3  
VISIBLE AND AUDIBLE ALARMS**

<b>NUMBER OF SLEEPING UNITS</b>	<b>SLEEPING ACCOMMODATIONS WITH VISIBLE AND AUDIBLE ALARMS</b>
6 to 25	2
26 to 50	4
51 to 75	7
76 to 100	9
101 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
501 to 1,000	5% of total
1,001 and over	50 plus 3 for each 100 over 1,000

**7.7.10.1.4 Group R-2.** In Group R-2 occupancies required by Section 7.7 to have a fire alarm system, all dwelling units and sleeping units shall be provided with the capability to support visible alarm notification appliances in accordance with ICC A117.1.

**7.7.10.2 Audible alarms.** Audible alarm notification appliances shall be provided and sound a distinctive sound that is not to be used for any purpose other than that of a fire alarm. The audible alarm notification appliances shall provide a sound pressure level of 15 decibels (dBA) above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, in every occupied space within the building. The minimum sound pressure levels shall be: 70 dBA in occupancies in Groups R and I-1; 90 dBA in mechanical equipment rooms; and 60 dBA in other occupancies. The maximum sound pressure level for audible alarm notification appliances shall be 120 dBA at the minimum hearing distance from the audible appliance. Where the average ambient noise is greater than 105 dBA, visible alarm notification appliances shall be provided in accordance with NFPA 72 and audible alarm notification appliances shall not be required.

**Exception:** Visible alarm notification appliances shall be allowed in lieu of audible alarm notification appliances in critical care areas of Group I-2 occupancies.

**7.7.11 Fire safety functions.** Automatic fire detectors utilized for the purpose of performing fire safety functions shall be connected to the building's fire alarm control panel where a fire alarm system is required by Section 7.7.2. Detectors shall, upon actuation, perform the intended function and activate the alarm notification appliances or activate a visible and audible supervisory signal at a constantly attended location. In buildings not required to be equipped with a fire alarm system, the automatic fire detector shall be powered by normal electrical service and, upon actuation, perform the intended function. The detectors shall be located in accordance with NFPA 72.

- 7.7.12 Duct smoke detectors.** Duct smoke detectors shall be connected to the building's fire alarm control panel when a fire alarm system is provided. Activation of a duct smoke detector shall initiate a visible and audible supervisory signal at a constantly attended location. Duct smoke detectors shall not be used as a substitute for required open area detection.
- Exceptions:**
1. The supervisory signal at a constantly attended location is not required where duct smoke detectors activate the building's alarm notification appliances.
  2. In occupancies not required to be equipped with a fire alarm system, actuation of a smoke detector shall activate a visible and an audible signal in an approved location. Smoke detector trouble conditions shall activate a visible or audible signal in an approved location and shall be identified as air duct detector trouble.
- 7.7.13 Access.** Access shall be provided to each detector for periodic inspection, maintenance and testing.
- 7.7.14 Fire-extinguishing systems.** Automatic fire-extinguishing systems shall be connected to the building fire alarm system where a fire alarm system is required by another section of these code requirements or is otherwise installed.
- 7.7.15 Monitoring.** Where required by this chapter or by the SBC 201, an approved supervising station in accordance with NFPA 72 shall monitor fire alarm systems.
- Exception:** Supervisory service is not required for:
1. Single and multiple-station smoke alarms required by Section 7.7.2.10.
  2. Smoke detectors in Group I-3 occupancies.
  3. Automatic sprinkler systems in one- and two-family dwellings.
- 7.7.16 Automatic telephone-dialing devices.** Automatic telephone-dialing devices used to transmit an emergency alarm shall not be connected to any Civil Defence telephone number unless approved by the Building official.
- 7.7.17 Acceptance tests.** Upon completion of the installation of the fire alarm system, alarm notification appliances and circuits, alarm-initiating devices and circuits, supervisory-signal initiating devices and circuits, signaling line circuits, and primary and secondary power supplies shall be tested in accordance with NFPA 72.
- 7.7.18 Record of completion.** A record of completion in accordance with NFPA 72 verifying that the system has been installed in accordance with the approved plans and specifications shall be provided.
- 7.7.19 Instructions.** Operating, testing and maintenance instructions and record drawings ("as built") and equipment specifications shall be provided at an approved location.
- 7.7.20 Inspection, testing and maintenance.** The maintenance and testing schedules and procedures for fire alarm and fire detection systems shall be in accordance with this section and Chapter 7 of NFPA 72.
- 7.7.20.1 Maintenance required.** Whenever or wherever any device, equipment, system, condition, arrangement, level of protection or any other feature is required for compliance with the provisions of these code requirements, such device,

equipment, system, condition, arrangement, level of protection or other feature shall thereafter be continuously maintained in accordance with applicable NFPA requirements or as directed by the Building official.

- 7.7.20.2 Testing.** Testing shall be performed in accordance with the schedules in Chapter 7 of NFPA 72 or more frequently where required by the Building official. Where automatic testing is performed at least weekly by a remotely monitored fire alarm control unit specifically listed for the application, the manual testing frequency shall be permitted to be extended to annual.

**Exception:** Devices or equipment that are inaccessible for safety considerations shall be tested during scheduled shutdowns where approved by the Building official, but not less than every 18 months.

- 7.7.20.3 Detector sensitivity.** Detector sensitivity shall be checked within 1 year after installation and every alternate year thereafter. After the second calibration test, where sensitivity tests indicate that the detector has remained within its listed and marked sensitivity range (or 4 percent obscuration light grey smoke, if not marked), the length of time between calibration tests shall be permitted to be extended to a maximum of 5 years. Where the frequency is extended, records of detector-caused nuisance alarms and subsequent trends of these alarms shall be maintained. In zones or areas where nuisance alarms show any increase over the previous year, calibration tests shall be performed.

- 7.7.20.4 Method.** To ensure that each smoke detector is within its listed and marked sensitivity range, it shall be tested using either a calibrated test method, the manufacturer's calibrated sensitivity test instrument, listed control equipment arranged for the purpose, a smoke detector/control unit arrangement whereby the detector causes a signal at the control unit where its sensitivity is outside its acceptable sensitivity range or other calibrated sensitivity test method acceptable to the Building official. Detectors found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned and recalibrated or replaced.

**Exceptions:**

1. Detectors listed as field adjustable shall be permitted to be either adjusted within the listed and marked sensitivity range and cleaned and recalibrated or they shall be replaced.
2. This requirement shall not apply to single-station smoke alarms.

- 7.7.20.4.1 Testing device.** Detector sensitivity shall not be tested or measured using a device that administers an unmeasured concentration of smoke or other aerosol into the detector.

- 7.7.20.5 Maintenance, inspection and testing.** The building owner shall be responsible for ensuring that the fire and life safety systems are maintained in an operable condition at all times. Service personnel shall meet the qualification requirements of NFPA 72 for maintaining, inspecting and testing such systems. A written record shall be maintained and shall be made available to the Building official.

## SECTION 7.8 EMERGENCY ALARM SYSTEMS

- 7.8.1 Group H occupancies.** Emergency alarms for the detection and notification of an emergency condition in Group H occupancies shall be provided as required in Chapter 25.

- 7.8.2 Group H-5 occupancy.** Emergency alarms for notification of an emergency condition in an HPM facility shall be provided as required in Section 16.3.12. A continuous gas detection system shall be provided for HPM gases in accordance

with Section 16.3.13.

- 7.8.3 **Highly toxic and toxic materials.** Where required by Section 35.4.2.2.10, a as detection system shall be provided for indoor storage and use of highly toxic and toxic compressed gases.
- 7.8.4 **Ozone gas-generator rooms.** A gas detection system shall be provided in ozone gas-generator rooms in accordance with Section 35.5.3.2.
- 7.8.5 **Repair garages.** A flammable-gas detection system shall be provided in repair garages for vehicles fueled by non-odorized gases in accordance with Section 20.11.7.2.
- 7.8.6 **Refrigeration systems.** Refrigeration system machinery rooms shall be provided with a refrigerant detector in accordance with Chapter 4 of the SBC 201.

## SECTION 7.9 SMOKE CONTROL SYSTEMS

- 7.9.1 **Scope and purpose.** This section applies to mechanical or passive smoke control systems when they are required for new buildings or portions thereof by provisions of the SBC 201 or these code requirements. The purpose of this section is to establish minimum requirements for the design, installation and acceptance testing of smoke control systems that are intended to provide a tenable environment for the evacuation or relocation of occupants. These provisions are not intended for the preservation of contents, the timely restoration of operations, or for assistance in fire suppression or overhaul activities. Smoke control systems regulated by this section serve a different purpose than the smoke and heat-venting provisions found in Section 7.10. Mechanical smoke control systems shall not be considered exhaust systems under Chapter 5 of the SBC 501.
- 7.9.2 **General design requirements.** Buildings, structures, or parts thereof required by the SBC 201 or these code requirements to have a smoke control system or systems shall have such systems designed in accordance with the applicable requirements of Section 7.9 and the generally accepted and well-established principles of engineering relevant to the design. The construction documents shall include sufficient information and detail to describe adequately the elements of the design necessary for the proper implementation of the smoke control systems. These documents shall be accompanied with sufficient information and analysis to demonstrate compliance with these provisions.
- 7.9.3 **Special inspection and test requirements.** In addition to the ordinary inspection and test requirements to which buildings, structures and parts thereof are required to undergo, smoke control systems subject to the provisions of Section 7.9 shall undergo special inspections and tests sufficient to verify the proper commissioning of the smoke control design in its final installed condition. The design submission accompanying the construction documents shall clearly detail procedures and methods to be used and the items subject to such inspections and tests. Such commissioning shall be in accordance with generally accepted engineering practice and, where possible, based on published standards for the particular testing involved. The special inspections and tests required by this section shall be conducted under the same terms as in the SBC 100.

- 7.9.4 Analysis.** A rational analysis supporting the types of smoke control systems to be employed, the methods of their operations, the systems supporting them, and the methods of construction to be utilized shall accompany the construction documents submission and include, but not be limited to, the items indicated in Sections 7.9.4.1 through 7.9.4.6.
- 7.9.4.1 Stack effect.** The system shall be designed such that the maximum probable normal or reverse stack effect will not adversely interfere with the system's capabilities. In determining the maximum probable stack effect, altitude, elevation, weather history and interior temperatures shall be used.
- 7.9.4.2 Temperature effect of fire.** Buoyancy and expansion caused by the design fire in accordance with Section 7.9.9 shall be analyzed. The system shall be designed such that these effects do not adversely interfere with the system's capabilities.
- 7.9.4.3 Wind effect.** The design shall consider the adverse effects of wind. Such consideration shall be consistent with the wind-loading provisions of the SBC 301.
- 7.9.4.4 Systems.** The design shall consider the effects of the heating, ventilating and air-conditioning (HVAC) systems on both smoke and fire transport. The analysis shall include all permutations of systems status. The design shall consider the effects of the fire on the heating, ventilating and air-conditioning systems.
- 7.9.4.5 Climate.** The design shall consider the effects of low temperatures on systems, property and occupants. Air inlets and exhausts shall be located so as to prevent snow or ice blockage.
- 7.9.4.6 Duration of operation.** All portions of active or passive smoke control systems shall be capable of continued operation after detection of the fire event for not less than 20 minutes.
- 7.9.5 Smoke barrier construction.** Smoke barriers shall comply with the SBC 201. Smoke barriers shall be constructed and sealed to limit leakage areas exclusive of protected openings. The maximum allowable leakage area shall be the aggregate area calculated using the following leakage area ratios:
1. Walls:  $A/A_w = 0.001\ 00$
  2. Exit enclosures:  $A/A_w = 0.00035$
  3. All other shafts:  $A/A_w = 0.00150$
  4. Floors and roofs:  $A/A_F = 0.00050$
- where:
- $A$  = Total leakage area,  $m^2$ .
- $A_F$  = Unit floor or roof area of barrier,  $m^2$ .
- $A_w$  = Unit wall area of barrier,  $m^2$ .
- The leakage area ratios shown do not include openings due to doors, operable windows or similar gaps. These shall be included in calculating the total leakage area.
- 7.9.5.1 Leakage area.** Total leakage area of the barrier is the product of the smoke barrier gross area monitored by the allowable leakage area ratio, plus the area of other openings such as gaps and operable windows. Compliance shall be determined by achieving the minimum air pressure difference across the barrier with the system in the smoke control mode for mechanical smoke control systems. Passive smoke control systems tested using other approved means such as door fan testing shall be as approved by the Building official.
- 7.9.5.2 Opening protection.** Openings in smoke barriers shall be protected by automatic-closing devices actuated by the required controls for the mechanical smoke control system. Door openings shall be protected by door assemblies complying with the

requirements of the SBC 201 for doors in smoke barriers.

**Exceptions:**

1. Passive smoke control systems with automatic-closing devices actuated by spot-type smoke detectors listed for releasing service installed in accordance with Section 7.7.11.
2. Fixed openings between smoke zones which are protected utilizing the airflow method.
3. In Group I-2, where such doors are installed across corridors, a pair of opposite-swinging doors without a center mullion shall be installed having vision panels with approved fire-rated glazing materials in approved fire-rated frames, the area of which shall not exceed that tested. The doors shall be close fitting within operational tolerances, and shall not have undercuts, louvers or grilles. The doors shall have head and jamb stops, astragals or rabbets at meeting edges, and automatic-closing devices. Positive-latching devices are not required.
4. Group I-3.
5. Openings between smoke zones with clear ceiling heights of 4.3 m or greater and bank-down capacity of greater than 20 minutes as determined by the design fire size.

**7.9.5.2.1 Ducts and air transfer openings.** Ducts and air transfer openings are required to be protected with a minimum Class II, 121°C smoke damper complying with the SBC 201.

**7.9.6 Pressurization method.** The primary mechanical means of controlling smoke shall be by pressure differences across smoke barriers. Maintenance of a tenable environment is not required in the smoke-control zone of fire origin.

**7.9.6.1 Minimum pressure difference.** The minimum pressure difference across a smoke barrier shall be 0.015 mm water gage in fully sprinklered buildings. In buildings allowed to be other than fully sprinklered, the smoke control system shall be designed to achieve pressure differences at least two times the maximum calculated pressure difference produced by the design fire.

**7.9.6.2 Maximum pressure difference.** The maximum air pressure difference across a smoke barrier shall be determined by required door-opening or closing forces. The actual force required to open exit doors when the system is in the smoke control mode shall be in accordance with Section 8.8.1.2. Opening and closing forces for other doors shall be determined by standard engineering methods for the resolution of forces and reactions. The calculated force to set a side-hinged, swinging door in motion shall be determined by:

$$F = F_{dc} + K(WA \Delta P)/2(W - d) \quad (\text{Equation 7-1})$$

Where:

- $A$  = Door area, m<sup>2</sup>.  
 $d$  = Distance from door handle to latch edge of door, m.  
 $F$  = Total door opening force, N.  
 $F_{dc}$  = Force required to overcome closing device, N.  
 $K$  = Coefficient 1.0.  
 $W$  = Door width, m.  
 $\Delta P$  = Design pressure difference, Pa.

**7.9.7 Airflow design method** When approved by the Building official, smoke migration through openings fixed in a permanently open position, which are located between smoke-control zones by the use of the airflow method, shall be permitted. The



design airflow shall be in accordance with this section. Airflow shall be directed to limit smoke migration from the fire zone. The geometry of openings shall be considered to prevent flow reversal from turbulent effects.

- 7.9.7.1 Velocity.** The minimum average velocity through a fixed opening shall not be less than:

$$v = 119.9 [h (T_f - T_o)/T_f]^{1/2} \quad \text{(Equation 7-2)}$$

Where:

- $h$  = Height of opening, m.
- $T_f$  = Temperature of smoke, °K.
- $T_o$  = Temperature of ambient air, °K.
- $v$  = Air velocity, m/minute.

- 7.9.7.2 Prohibited conditions.** This method shall not be employed where either the quantity of air or the velocity of the airflow will adversely affect other portions of the smoke control system, unduly intensify the fire, disrupt plume dynamics or interfere with exiting. In no case shall airflow toward the fire exceed 1.02 m/s. Where the formula in Section 7.9.7.1 requires airflows to exceed this limit, the airflow method shall not be used.

- 7.9.8 Exhaust method.** When approved by the Building official, mechanical smoke control for large enclosed volumes, such as in atriums or malls, shall be permitted to utilize the exhaust method. The design exhaust volumes shall be in accordance with this section.

- 7.9.8.1 Exhaust rate.** The height of the lowest horizontal surface of the accumulating smoke layer shall be maintained at least 3.0 m above any walking surface which forms a portion of a required egress system within the smoke zone. The required exhaust rate for the zone shall be the largest of the calculated plume mass flow rates for the possible plume configurations. Provisions shall be made for natural or mechanical supply of air from outside or adjacent smoke zones to make up for the air exhausted. Makeup airflow rates, when measured at the potential fire location, shall not exceed 1.02 m/s toward the fire. The temperature of the makeup air shall be such that it does not expose temperature-sensitive fire protection systems beyond their limits.

- 7.9.8.2 Axisymmetric plumes.** The plume mass flow rate ( $m_p$ ), in kg/s, shall be determined by placing the design fire center on the axis of the space being analyzed. The limiting flame height shall be determined by:

$$z_l = 0.166 Q_c^{2/5} \quad \text{(Equation 7-3)}$$

Where:

- $m_p$  = Plume mass flow rate, kg/s.
- $Q$  = Total heat output.
- $Q_c$  = Convective heat output, kW. (The value of  $Q_c$  shall not be taken as less than 0.70  $Q$ .)
- $z$  = Height from top of fuel surface to bottom of smoke layer, m.
- $z_l$  = Limiting flame height, m. The  $z_l$  value must be greater than the fuel equivalent diameter (see Section 7.9.9).

for  $z > z_l$

$$m_p = 0.071 Q_c^{1/3} z^{5/3} + 0.0018 Q_c$$

for  $z > z_l$

$$m_p = 0.035 Q_c$$

for  $z > z_l$

$$m_p = 0.032 Q_c^{3/5} z$$

To convert  $m_p$  from pounds per second of mass flow to a volumetric rate, the following formula shall be used:

$$V = 60 m_p / \rho \quad \text{(Equation 7-4)}$$

Where:

$V$  = Volumetric flow rate,  $\text{m}^3/\text{s}$ .

$\rho$  = Density of air at the temperature of the smoke layer,  $[\text{kg}/\text{m}^3 (T: \text{in } ^\circ\text{C})]$ .

**7.9.8.3 Balcony spill plumes.** The plume mass flow rate ( $m_p$ ) for spill plumes shall be determined using the geometrically probable width based on architectural elements and projections in the following equation:

$$m_p = 0.36(QW^2)^{1/3} (z_b + 0.25H) \quad \text{(Equation 7-5)}$$

Where:

$H$  = Height above fire to underside of balcony, m.

$m_p$  = Plume mass flow rate,  $\text{kg}/\text{s}$ .

$Q$  = Total heat output.

$W$  = Plume width at point of spill, m.

$z_b$  = Height from balcony, m.

**7.9.8.4 Window plumes.** The plume mass flow rate ( $m_p$ ) shall be determined from:

$$m_p = 0.68(A_w H_w^{1/2})^{1/3} (z_w + a)^{5/3} + 1.5 A_w H_w^{1/2} \quad \text{(Equation 7-6)}$$

Where:

$A_w$  = Area of the opening, square  $\text{m}^2$ .

$H_w$  = Height of the opening, m.

$m_p$  = Plume mass flow rate,  $\text{kg}/\text{s}$ .

$z_w$  = Height from the top of the window or opening to the bottom of the smoke layer, m.

$a$  =  $2.4 A_w^{2/5} H_w^{1/5} - 2.1 H_w$

**7.9.8.5 Plume contact with walls.** When a plume contacts one or more of the surrounding walls, the mass flow rate shall be adjusted for the reduced entrainment resulting from the contact provided that the contact remains constant. Use of this provision requires calculation of the plume diameter, that shall be calculated by:

$$d = 0.48 (T_c/T_a)^{1/2} z \quad \text{(Equation 7-7)}$$

Where:

$d$  = Plume diameter, m.

$T_a$  = Ambient air temperature,  $^\circ\text{K}$ .

$T_c$  = Plume centerline temperature,  $^\circ\text{K}$ .

$z$  = Height at which  $T_c$  is determined, m.

$T_c$  =  $0.08 T_a Q_c^{2/3} z^{-5/3} + T_a$

**7.9.9 Design fire.** The design fire shall be based on a  $Q$  of not less than 5,275 kW unless a rational analysis is performed by the registered design professional and approved by the Building official. The design fire shall be based on the analysis in accordance with Section 7.9.4 and this section.

**7.9.9.1 Factors considered.** The engineering analysis shall include the characteristics of the fuel, fuel load, effects included by the fire, and whether the fire is likely to be steady or unsteady.

**7.9.9.2 Separation distance.** Determination of the design fire shall include consideration of the type of fuel, fuel spacing and configuration. The ratio of the separation distance to the fuel equivalent radius shall not be less than 4. The fuel equivalent radius shall be the radius of a circle of equal area to floor area of the fuel package. The design fire shall be increased if other combustibles are within the separation distance as determined by:

$$R = [Q/(12 \pi q'')]^{1/2} \quad \text{(Equation 7-8)}$$

Where:

$q''$  = Incident radiant heat flux required for nonpiloted ignition, W/m<sup>2</sup>.

$Q$  = Heat release from fire, kW.

$R$  = Separation distance from target to center of fuel package, m.

**7.9.9.3 Heat-release assumptions.** The analysis shall make use of best available data from approved sources and shall not be based on excessively stringent limitations of combustible material.

**7.9.9.4 Sprinkler effectiveness assumptions.** A documented engineering analysis shall be provided for conditions that assume fire growth is halted at the time of sprinkler activation.

**7.9.10 Equipment.** Equipment such as, but not limited to, fans, ducts, automatic dampers and balance dampers, shall be suitable for their intended use, suitable for the probable exposure temperatures that the rational analysis indicates, and as approved by the Building official.

**7.9.10.1 Exhaust fans.** Components of exhaust fans shall be rated and certified by the manufacturer for the probable temperature rise to which the components will be exposed. This temperature rise shall be computed by:

$$T_s = (Q_c/mc) + (T_a) \quad \text{(Equation 7-9)}$$

Where:

$c$  = Specific heat of smoke at smokelayer temperature, kJ/kg · °K.

$m$  = Exhaust rate, kg/s.

$Q_c$  = Convective heat output of fire, kW.

$T_a$  = Ambient temperature, °K.

$T_s$  = Smoke temperature, °K.

**Exception:** Reduced  $T_s$  as calculated based on the assurance of adequate dilution air.

**7.9.10.2 Ducts.** Duct materials and joints shall be capable of withstanding the probable temperatures and pressures to which they are exposed as determined in accordance with Section 7.9.10.1. Ducts shall be constructed and supported in accordance with the SBC 501. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5 percent of design flow. Results of such testing shall be a part of the documentation procedure. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports.

**Exception:** Flexible connections (for the purpose of vibration isolation) complying with the SBC 501 and which are constructed of approved fire-resistance-rated materials.

**7.9.10.3 Equipment, inlets and outlets.** Equipment shall be located so as to not expose uninvolved portions of the building to an additional fire hazard. Outside air inlets

shall be located so as to minimize the potential for introducing smoke or flame into the building. Exhaust outlets shall be so located as to minimize reintroduction of smoke into the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.

- 7.9.10.4 Automatic dampers.** Automatic dampers, regardless of the purpose for which they are installed within the smoke control system, shall be listed and conform to the requirements of approved recognized standards.
- 7.9.10.5 Fans.** In addition to other requirements, belt-driven fans shall have 1.5 times the number of belts required for the design duty with the minimum number of belts being two. Fans shall be selected for stable performance based on normal temperature and, where applicable, elevated temperature. Calculations and manufacturer's fan curves shall be part of the documentation procedures. Fans shall be supported and restrained by noncombustible devices in accordance with the structural design requirements of the SBC 301. Motors driving fans shall not be operated beyond their nameplate horsepower (kilowatts) as determined from measurement of actual current draw and shall have a minimum service factor of 1.15.
- 7.9.11 Power systems.** The smoke control system shall be supplied with two sources of power. Primary power shall be the normal building power systems. Secondary power shall be from an approved standby source complying with the SBC 401. The standby power source and its transfer switches shall be in a separate room from the normal power transformers and switch gear and shall be enclosed in a room constructed of not less than 1 hour fire-resistance-rated fire barriers, ventilated directly to and from the exterior. Power distribution from the two sources shall be by independent routes. Transfer to full standby power shall be automatic and within 60 seconds of failure of the primary power. The systems shall comply with the SBC 401.
- 7.9.11.1 Power sources and power surges.** Elements of the smoke management system relying on volatile memories or the like shall be supplied with uninterruptable power sources of sufficient duration to span 15-minute primary power interruption. Elements of the smoke management system susceptible to power surges shall be suitably protected by conditioners, suppressors or other approved means.
- 7.9.12 Detection and control systems.** Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Section 7.7. Such systems shall be equipped with a control unit complying with UL 864 and listed as smoke control equipment. Control systems for mechanical smoke control systems shall include provisions for verification. Verification shall include positive confirmation of actuation, testing, manual override, the presence of power downstream of all disconnects and, through a preprogrammed weekly test sequence report, abnormal conditions audibly, visually and by printed report.
- 7.9.12.1 Wiring.** In addition to meeting requirements of the SBC 401, all wiring, regardless of voltage, shall be fully enclosed within continuous raceways.
- 7.9.12.2 Activation.** Smoke control systems shall be activated in accordance with this section.
- 7.9.12.2.1 Pressurization, airflow or exhaust method.** Mechanical smoke control systems using the pressurization, airflow or exhaust method shall have completely automatic control.

- 7.9.12.2.2 Passive method.** Passive smoke control systems actuated by approved spot-type detectors listed for releasing service shall be permitted.
- 7.9.12.3 Automatic control.** Where completely automatic control is required or used, the automatic-control sequences shall be initiated from an appropriately zoned automatic sprinkler system complying with Section 7.3.3.1.1, manual controls that are readily accessible to the Civil Defence, and any smoke detectors required by the engineering analysis.
- 7.9.13 Control air tubing.** Control air tubing shall be of sufficient size to meet the required response times. Tubing shall be flushed clean and dry prior to final connections and shall be adequately supported and protected from damage. Tubing passing through concrete or masonry shall be sleeved and protected from abrasion and electrolytic action.
- 7.9.13.1 Materials.** Control air tubing shall be hard drawn copper, Type L, ACR in accordance with ASTM B 42, ASTM B 43, ASTM B 68, ASTM B 88, ASTM B 251 and ASTM B 280. Fittings shall be wrought copper or brass, solder type, in accordance with ASME B 16.18 or ASME B 16.22. Changes in direction shall be made with appropriate tool bends. Brass compression-type fittings shall be used at final connection to devices; other joints shall be brazed using a BCuP5 brazing alloy with solidus above 593°C and liquids below 816°C. Brazing flux shall be used on copper-to-brass joints only.
- Exception:** Nonmetallic tubing used within control panels and at the final connection to devices, provided all of the following conditions are met:
1. Tubing shall be listed by an approved agency for flame and smoke characteristics.
  2. Tubing and the connected device shall be completely enclosed within a galvanized or paint-grade steel enclosure of not less than 0.76 mm (No. 22 galvanized sheet gage) thickness. Entry to the enclosure shall be by copper tubing with a protective grommet of neoprene or teflon or by suitable brass compression to male-barbed adapter.
  3. Tubing shall be identified by appropriately documented coding.
  4. Tubing shall be neatly tied and supported within enclosure. Tubing bridging cabinet and door or moveable device shall be of sufficient length to avoid tension and excessive stress. Tubing shall be protected against abrasion. Tubing serving devices on doors shall be fastened along hinges.
- 7.9.13.2 Isolation from other functions.** Control tubing serving other than smoke control functions shall be isolated by automatic isolation valves or shall be an independent system.
- 7.9.13.3 Testing.** Control air tubing shall be tested at three times the operating pressure for not less than 30 minutes without any noticeable loss in gauge pressure prior to final connection to devices.
- 7.9.14 Marking and identification.** The detection and control systems shall be clearly marked at all junctions, accesses and terminations.
- 7.9.15 Control diagrams.** Identical control diagrams showing all devices in the system and identifying their location and function shall be maintained current and kept on file with the Building official, the Civil Defence and in the fire command center in format and manner approved by the Building official.
- 7.9.16 Fire-fighter's smoke control panel.** A fire-fighter's smoke control panel for Civil Defence emergency response purposes only shall be provided and shall include

manual control or override of automatic control for mechanical smoke control systems. The panel shall be located in a fire command center complying with Section 5C.9 and shall comply with Sections 7.9.16.1 through 7.9.16.3.

**7.9.16.1 Smoke control systems.** Fans within the building shall be shown on the fire-fighter's control panel. A clear indication of the direction of airflow and the relationship of components shall be displayed. Status indicators shall be provided for all smoke control equipment, annunciated by fan and zone and by pilot-lamp-type indicators as follows:

1. Fans, dampers and other operating equipment in their normal status – WHITE.
2. Fans, dampers and other operating equipment in their off or closed status – RED.
3. Fans, dampers and other operating equipment in their on or open status – GREEN.
4. Fans, dampers and other operating equipment in a fault status – YELLOW/AMBER.

**7.9.16.2 Smoke control panel.** The fire-fighter's control panel shall provide control capability over the complete smoke-control system equipment within the building as follows:

1. ON-AUTO-OFF control over each individual piece of operating smoke control equipment that can also be controlled from other sources within the building. This includes stairway pressurization fans; smoke exhaust fans; supply, return and exhaust fans; elevator shaft fans; and other operating equipment used or intended for smoke control purposes.
2. OPEN-AUTO-CLOSE control over individual dampers relating to smoke control and that are also controlled from other sources within the building.
3. ON-OFF or OPEN-CLOSE control over smoke control and other critical equipment associated with a fire or smoke emergency and that can only be controlled from the fire-fighter's control panel.

**Exceptions:**

1. Complex systems, where approved, where the controls and indicators are combined to control and indicate all elements of a single smoke zone as a unit.
2. Complex systems, where approved, where the control is accomplished by computer interface using approved, plain English commands.

**7.9.16.3 Control action and priorities.** The fire-fighter's control panel actions shall be as follows:

1. ON-OFF, OPEN-CLOSE control actions shall have the highest priority of any control point within the building. Once issued from the fire-fighter's control panel, no automatic or manual control from any other control point within the building shall contradict the control action. Where automatic means are provided to interrupt normal, nonemergency equipment operation or produce a specific result to safeguard the building or equipment (i.e., duct freezestats, duct smoke detectors, high-temperature cutouts, temperature-actuated linkage and similar devices), such means shall be capable of being overridden by the fire-fighter's control panel. The last control action as indicated by each fire-fighter's control panel switch position shall prevail. In no case shall control actions require the smoke control system to assume more than one configuration at any one time.

**Exception:** Power disconnects required by the SBC 401.

2. Only the AUTO position of each three-position fire-fighter's control panel switch shall allow automatic or manual control action from other control points within the building. The AUTO position shall be the NORMAL,

nonemergency, building control position. Where a fire-fighter's control panel is in the AUTO position, the actual status of the device (on, off, open, closed) shall continue to be indicated by the status indicator described above. When directed by an automatic signal to assume an emergency condition, the NORMAL position shall become the emergency condition for that device or group of devices within the zone. In no case shall control actions require the smoke control system to assume more than one configuration at any one time.

- 7.9.17 System response time.** Smoke-control system activation shall be initiated immediately after receipt of an appropriate automatic or manual activation command. Smoke control systems shall activate individual components (such as dampers and fans) in the sequence necessary to prevent physical damage to the fans, dampers, ducts and other equipment. For purposes of smoke control, the fire-fighter's control panel response time shall be the same for automatic or manual smoke control action initiated from any other building control point. The total response time, including that necessary for detection, shutdown of operating equipment and smoke control system startup, shall allow for full operational mode to be achieved before the conditions in the space exceed the design smoke condition. The system response time for each component and their sequential relationships shall be detailed in the required rational analysis and verification of their installed condition reported in the required final report.
- 7.9.18 Acceptance testing.** Devices, equipment, components and sequences shall be individually tested. These tests, in addition to those required by other provisions of these code requirements, shall consist of determination of function, sequence and, where applicable, capacity of their installed condition.
- 7.9.18.1 Detection devices.** Smoke or fire detectors that are a part of a smoke control system shall be tested in accordance with Chapter 7 in their installed condition. When applicable, this testing shall include verification of airflow in both minimum and maximum conditions.
- 7.9.18.2 Ducts.** Ducts that are part of a smoke control system shall be traversed using generally accepted practices to determine actual air quantities.
- 7.9.18.3 Dampers.** Dampers shall be tested for function in their installed condition.
- 7.9.18.4 Inlets and outlets.** Inlets and outlets shall be read using generally accepted practices to determine air quantities.
- 7.9.18.5 Fans.** Fans shall be examined for correct rotation. Measurements of voltage, amperage, revolutions per minute and belt tension shall be made.
- 7.9.18.6 Smoke barriers.** Measurements using inclined manometers or other approved calibrated measuring devices shall be made of the pressure differences across smoke barriers. Such measurements shall be conducted for each possible smoke control condition.
- 7.9.18.7 Controls.** Each smoke zone, equipped with an automatic-initiation device, shall be put into operation by the actuation of one such device. Each additional device within the zone shall be verified to cause the same sequence without requiring the operation of fan motors in order to prevent damage. Control sequences shall be verified throughout the system, including verification of override from the fire-fighter's control panel and simulation of standby power conditions.
- 7.9.18.8 Special inspections for smoke control.** Smoke control systems shall be tested by a special inspector.
- 7.9.18.8.1 Scope of testing.** Special inspections shall be conducted in accordance with the following:

1. During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.
  2. Prior to occupancy and after sufficient completion for the purposes of pressure-difference testing, flow measurements, and detection and control verification.
- 7.9.18.8.2 Qualifications.** Special inspection agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers.
- 7.9.18.8.3 Reports.** A complete report of testing shall be prepared by the special inspector or special inspection agency. The report shall include identification of all devices by manufacturer, nameplate data, design values, measured values and identification tag or mark. The report shall be reviewed by the responsible registered design professional and, when satisfied that the design intent has been achieved, the responsible registered design professional shall seal, sign and date the report.
- 7.9.18.8.3.1 Report filing.** A copy of the final report shall be filed with the Building official and an identical copy shall be maintained in an approved location at the building.
- 7.9.18.9 Identification and documentation.** Charts, drawings and other documents identifying and locating each component of the smoke control system, and describing their proper function and maintenance requirements, shall be maintained on file at the building as an attachment to the report required by Section 7.9.18.8.3. Devices shall have an approved identifying tag or mark on them consistent with the other required documentation and shall be dated indicating the last time they were successfully tested and by whom.
- 7.9.19 System acceptance.** Buildings, or portions thereof, required by these code requirements to comply with this section shall not be issued a certificate of occupancy until such time that the Building official determines that the provisions of this section have been fully complied with, and that the Civil Defence has received satisfactory instruction on the operation, both automatic and manual, of the system.
- Exception:** In buildings of phased construction, a temporary certificate of occupancy, as approved by the Building official, shall be permitted provided that those portions of the building to be occupied meet the requirements of this section and that the remainder does not pose a significant hazard to the safety of the proposed occupants or adjacent buildings.
- 7.9.20 Smokeproof enclosures.** Where required by Section 8.19.1.8 of the SBC 201, a smokeproof enclosure shall be constructed in accordance with this section. A smokeproof enclosure shall consist of an enclosed interior exit stairway that conforms to Section 8.19.1 of the SBC 201, and an outside balcony or ventilated vestibule meeting the requirements of this section. Where access to the roof is required by these code requirements, such access shall be from the smokeproof enclosure where a smokeproof enclosure is required.
- 7.9.20.1 Access.** Access to the stair shall be byway of a vestibule or an open exterior balcony. The minimum dimension of the vestibule shall not be less than the required width of the corridor leading to the vestibule but shall not have a width of less than 1.1 m and shall not have a length of less than 1.8 m in the direction of egress travel.
- 7.9.20.2 Construction.** The smokeproof enclosure shall be separated from the remainder of the building by not less than a 2 hours fire-resistance-rated fire barrier without openings other than the required means of egress doors. The vestibule shall be separated from the stairway by not less than a 2 hours fire-resistance-rated fire



barrier. The open exterior balcony shall be constructed in accordance with the fire-resistance-rating requirements for floor construction.

- 7.9.20.2.1 Door closers.** Doors in a smokeproof enclosure shall be self-closing or shall be automatic-closing by actuation of a smoke detector installed at the floor-side entrance to the smokeproof enclosure in accordance with Section 4B.16.4.7. The actuation of the smoke detector on any door shall activate the closing devices on all doors in the smokeproof enclosure at all levels. Smoke detectors shall be installed in accordance with Section 7.7.11.
- 7.9.20.3 Natural ventilation alternative.** The provisions of Sections 7.9.20.3.1 through 7.9.20.3.3 shall apply to ventilation of smokeproof enclosures by natural means.
- 7.9.20.3.1 Balcony doors.** Where access to the stairway is by way of an open exterior balcony, the door assembly into the enclosure shall be a fire door in accordance with Section 4B.16.4.
- 7.9.20.3.2 Vestibule doors.** Where access to the stairway is by way of a vestibule, the door assembly into the vestibule shall be a fire door complying with Section 4B.16.4. The door assembly from the vestibule to the stairway shall have not less than a 20 minutes fire protection rating complying with Section 4B.16.4.
- 7.9.20.3.3 Vestibule ventilation.** Each vestibule shall have a minimum net area of 1.5 m<sup>2</sup> of opening in a wall facing an outer court, yard or public way that is at least 6.1 m in width.
- 7.9.20.4 Mechanical ventilation alternative.** The provisions of Sections 7.9.20.4.1 through 7.9.20.4.4 shall apply to ventilation of smokeproof enclosures by mechanical means.
- 7.9.20.4.1 Vestibule doors.** The door assembly from the building into the vestibule shall be a fire door complying with Section 4B.16.4. The door assembly from the vestibule to the stairway shall have not less than a 20 minutes fire protection rating in accordance with Section 4B.16.4. The door from the building into the vestibule shall be provided with gaskets or other provisions to minimize air leakage.
- 7.9.20.4.2 Vestibule ventilation.** The vestibule shall be supplied with not less than one air change per minute and the exhaust shall not be less than 150 percent of supply. Supply air shall enter and exhaust air shall discharge from the vestibule through separate, tightly constructed ducts used only for that purpose. Supply air shall enter the vestibule within 150 mm of the floor level. The top of the exhaust register shall be located at the top of the smoke trap but not more than 150 mm down from the top of the trap, and shall be entirely within the smoke trap area. Doors in the open position shall not obstruct duct openings. Duct openings with controlling dampers are permitted where necessary to meet the design requirements, but dampers are not otherwise required.
- 7.9.20.4.2.1 Engineered ventilation system.** Where a specially engineered system is used, the system shall exhaust a quantity of air equal to not less than 90 air changes per hour from any vestibule in the emergency operation mode and shall be sized to handle three vestibules simultaneously. Smoke detectors shall be located at the floor-side entrance to each vestibule and shall activate the system for the affected vestibule. Smoke detectors shall be installed in accordance with Section 7.7.11.
- 7.9.20.4.3 Smoke trap.** The vestibule ceiling shall be at least 0.50 m higher than the door opening into the vestibule to serve as a smoke and heat trap and to provide an upward-moving air column. The height shall not be decreased unless approved and justified by design and test.
- 909.20.4.4 Stair shaft air movement system.** The stair shaft shall be provided with a dampered relief opening and supplied with sufficient air to maintain a minimum positive pressure of 25 Pa in the shaft relative to the vestibule with all doors closed.

- 7.9.20.5 Stair pressurization alternative.** Where the building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, the vestibule is not required, provided that interior exit stairways are pressurized to a minimum of 37 Pa and a maximum of 87 Pa in the shaft relative to the building measured with all stairway doors closed under maximum anticipated stack pressures.
- 7.9.20.6 Ventilating equipment.** The activation of ventilating equipment required by the alternatives in Sections 7.9.20.4 and 7.9.20.5 shall be by smoke detectors installed at each floor level at an approved location at the entrance to the smokeproof enclosure. When the closing device for the stair shaft and vestibule doors is activated by smoke detection or power failure, the mechanical equipment shall activate and operate at the required performance levels. Smoke detectors shall be installed in accordance with Section 7.7.11.
- 7.9.20.6.1 Ventilation systems.** Smokeproof enclosure ventilation systems shall be independent of other building ventilation systems. The equipment and ductwork shall comply with one of the following:
1. Equipment and ductwork shall be located exterior to the building and directly connected to the smokeproof enclosure or connected to the smokeproof enclosure by ductwork enclosed by 2 hours fire-resistance-rated fire barriers.
  2. Equipment and ductwork shall be located within the smokeproof enclosure with intake or exhaust directly from and to the outside or through ductwork enclosed by 2 hours fire-resistance-rated fire barriers.
  3. Equipment and ductwork shall be located within the building if separated from the remainder of the building, including other mechanical equipment, by 2 hours fire-resistance-rated fire barriers.
- 7.9.20.6.2 Standby power.** Mechanical vestibule and stair shaft ventilation systems and automatic fire detection systems shall be powered by an approved standby power system conforming to Section 2.16.10.1 of the SBC 201 and SBC 501.
- 7.9.20.6.3 Acceptance and testing.** Before the mechanical equipment is approved, the system shall be tested in the presence of the building official to confirm that the system is operating in compliance with these requirements.
- 7.9.21 Underground building smoke exhaust system.** Where required by the SBC 201 for underground buildings, a smoke exhaust system shall be provided in accordance with this section.
- 7.9.21.1 Exhaust capability.** Where compartmentation is required, each compartment shall have an independent, automatically activated smoke exhaust system capable of manual operation. The system shall have an air supply and smoke exhaust capability that will provide a minimum of six air changes per hour.
- 7.9.21.2 Operation.** The smoke exhaust system shall be operated in the compartment of origin by the following, independently of each other:
1. Two cross-zoned smoke detectors within a single protected area or a single smoke detector monitored by an alarm verification zone or an approved equivalent method.
  2. The automatic sprinkler system.
  3. Manual controls that are readily accessible to the Civil Defence.
- 7.9.21.3 Alarm required.** Activation of the smoke exhaust system shall activate an audible alarm at a constantly attended location.
- 7.9.22 Maintenance.** Smoke control systems shall be maintained to ensure to a reasonable degree that the system is capable of controlling smoke for the duration required. The system shall be maintained in accordance with the manufacturer's instructions and Sections 7.9.22.1 through 7.9.22.5.

- 7.9.22.1 **Schedule.** A routine maintenance and operational testing program shall be initiated immediately after the smoke control system has passed the acceptance tests. A written schedule for routine maintenance and operational testing shall be established.
- 7.9.22.2 **Written record.** A written record of smoke control system testing and maintenance shall be maintained on the premises. The written record shall include the date of the maintenance, identification of the servicing personnel and notification of any unsatisfactory condition and the corrective action taken, including parts replaced.
- 7.9.22.3 **Testing.** Operational testing of the smoke control system shall include all equipment such as initiating devices, fans, dampers, controls, doors and windows.
- 7.9.22.4 **Dedicated smoke control systems.** Dedicated smoke control systems shall be operated for each control sequence semi-annually. The system shall also be tested under standby power conditions.
- 7.9.22.5 **Nondedicated smoke control systems.** Nondedicated smoke control systems shall be operated for each control sequence annually. The system shall also be tested under standby power conditions.

## SECTION 7.10

### SMOKE AND HEAT VENTS

- 7.10.1 **General.** Where required by these code requirements or otherwise installed, smoke and heat vents, or mechanical smoke exhaust systems, and draft curtains shall conform to the requirements of this section.  
**Exception:** Frozen food warehouses used solely for storage of Class I and Class II commodities where protected by an approved automatic sprinkler system.
- 7.10.2 **Where required.** Approved smoke and heat vents shall be installed in the roofs of one-story buildings or portions thereof occupied for the uses set forth in Sections 7.10.2.1 through 7.10.2.4.
- 7.10.2.1 **Groups F-1 and S1.** Buildings and portions thereof used as a Group F-1 or S-1 occupancy having more than 4,645 m<sup>2</sup> of undivided area.  
**Exception:** Group S-1 aircraft repair hangars.
- 7.10.2.2 **Group H.** Buildings and portions thereof used as a Group H occupancy as follows:
  - 1. In occupancies classified as Group H-2 or H-3, any of which are more than 1,394 m<sup>2</sup> in single floor area.  
**Exception:** Buildings of noncombustible construction containing only noncombustible materials.
  - 2. In areas of buildings in Group H used for storing Class 2, 3 and 4 liquid and solid oxidizers, Class 1 and unclassified detonable organic peroxides, Class 3 and 4 unstable (reactive) materials, or Class 2 or 3 water-reactive materials as required for a high-hazard commodity classification.  
**Exception:** Buildings of noncombustible construction containing only noncombustible materials.
- 7.10.2.3 **High-piled combustible storage.** Buildings and portions thereof containing high-piled combustible stock or rack storage in any occupancy group when required by Section 21.6.7.
- 7.10.2.4 **Exit access travel distance increase.** Buildings and portions thereof used as a Group F-1 or S-1 occupancy where the maximum exit access travel distance is increased with Section 8.15.2.

- 7.10.3 Design and installation.** The design and installation of smoke and heat vents and draft curtains shall be as specified in this section and Table 7.10.3.
- 7.10.3.1 Vent operation.** Smoke and heat vents shall be approved and labeled and shall be capable of being operated by approved automatic and manual means. Automatic operation of smoke and heat vents shall conform to the provisions of this section.
- 7.10.3.1.1 Gravity-operated drop out vents.** Automatic smoke and heat vents containing heat-sensitive glazing designed to shrink and drop out of the vent opening when exposed to fire shall fully open within 5 minutes after the vent cavity is exposed to a simulated fire represented by a time-temperature gradient that reaches an air temperature of 260°C within 5 minutes.
- 7.10.3.1.2 Sprinklered buildings.** Where installed in buildings equipped with an approved automatic sprinkler system, smoke and heat vents shall be designed to operate automatically.
- 7.10.3.1.3 Nonsprinklered buildings.** Where installed in buildings not equipped with an approved automatic sprinkler system, smoke and heat vents shall operate automatically by actuation of a heat-responsive device rated at between 38°C and 104°C above ambient.
- Exception:** Gravity-operated drop out vents complying with Section 7.10.3.1.1.
- 7.10.3.2 Vent dimensions.** The effective venting area shall not be less than 1.5 m<sup>2</sup> with no dimension less than 1.2 m, excluding ribs or gutters having a total width not exceeding 150 mm.

**TABLE 7.10.3**  
**REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS<sup>a</sup>**

OCCUPANCY GROUP AND COMMODITY CLASSIFICATION	DESIGNATED STORAGE HEIGHT (m)	MINIMUM DRAFT CURTAIN DEPTH (m)	MAXIMUM AREA FORMED BY DRAFT CURTAINS (m <sup>2</sup> )	VENT AREA TO FLOOR AREA RATIO	MAXIMUM SPACING OF VENT CENTERS (m)	MAXIMUM DISTANCE TO VENTS FROM WALL OR DRAFT CURTAIN <sup>b</sup> (m)
Group F-1	—	0.1 x H but ≥ 1.2	4,645	1:100	36.6	18.3
Group S-1 I-IV (Option 1)	≤ 6.1	1.8	929	1:100	30.5	18.3
	>6.1 ≤ 12.2	1.8	743	1:75	30.5	16.8
Group S-1 I-IV (Option 2)	≤ 6.1	1.2	278.7	1:75	30.5	16.8
	>6.1 ≤ 12.2	1.2	278.7	1:50	30.5	16.8
Group S-1 High hazard (Option 1)	≤ 6.1	1.8	557	1:50	30.5	16.8
	>6.1 ≤ 9.1	1.8	557	1:40	27.4	13.7
Group S-1 High hazard (Option 2)	≤ 6.1	1.2	371.6	1:50	30.5	16.8
	>6.1 ≤ 9.1	1.2	185.8	1:30	22.9	12.2

- a. Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 21. For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.
- b. The distance specified is the maximum distance from any vent in a particular draft curtained area to walls or draft curtains which form the perimeter of the draft curtained area.

- 7.10.3.3 Vent locations.** Smoke and heat vents shall be located 6.1 m or more from adjacent lot lines and fire walls and 3 m or more from fire barrier walls. Vents shall be uniformly located within the roof area above high-piled storage areas, with consideration given to roof pitch, draft curtain location, sprinkler location and structural members.

**7.10.3.4 Draft curtains.** Where required, draft curtains shall be provided in accordance with this section.

**Exception:** Where areas of buildings are equipped with early suppression fast-response (ESFR) sprinklers, draft curtains shall not be provided within these areas. Draft curtains shall only be provided at the separation between the ESFR sprinklers and the conventional sprinklers.

**7.10.3.4.1 Construction.** Draft curtains shall be constructed of sheet metal, lath and plaster, gypsum board or other approved materials that provide equivalent performance to resist the passage of smoke. Joints and connections shall be smoke tight.

**7.10.3.4.2 Location and depth.** The location and minimum depth of draft curtains shall be in accordance with Table 7.10.3.

**7.10.4 Mechanical smoke exhaust.** Where approved by the Building official, engineered mechanical smoke exhaust shall be an acceptable alternative to smoke and heat vents.

**7.10.4.1 Location.** Exhaust fans shall be uniformly spaced within each draft-curtained area and the maximum distance between fans shall not be greater than 30.5 m.

**7.10.4.2 Size.** Fans shall have a maximum individual capacity of 14.2 m<sup>3</sup>/s. The aggregate capacity of smoke exhaust fans shall be determined by the equation:

$$C = A \times 300 \quad \text{(Equation 7-10)}$$

where:

$C$  = Capacity of mechanical ventilation required, in m<sup>3</sup>/s.

$A$  = Area of roof vents provided in m<sup>2</sup> in accordance with Table 7.10.3.

**7.10.4.3 Operation.** Mechanical smoke exhaust fans shall be automatically activated by the automatic sprinkler system or by heat detectors having operating characteristics equivalent to those described in Section 7.10.3.1. Individual manual controls of each fan unit shall also be provided.

**7.10.4.4 Wiring and control.** Wiring for operation and control of smoke exhaust fans shall be connected ahead of the main disconnect and protected against exposure to temperatures in excess of 538°C for a period of not less than 15 minutes. Controls shall be located so as to be immediately accessible to the fire service from the exterior of the building and protected against interior fire exposure by fire barriers having a fire-resistance rating not less than 1 hour.

**7.10.4.5 Supply air.** Supply air for exhaust fans shall be provided at or near the floor level and shall be sized to provide a minimum of 50 percent of required exhaust. Openings for supply air shall be uniformly distributed around the periphery of the area served.

**7.10.4.6 Interlocks.** On combination comfort air-handling/smoke removal systems or independent comfort air-handling systems, fans shall be controlled to shut down in accordance with the approved smoke control sequence.

## SECTION 7.11 EXPLOSION CONTROL

**7.11.1 General.** Explosion control shall be provided in the following locations:

1. Where a structure, room or space is occupied for purposes involving explosion hazards as identified in Table 7.11.1.
2. Where quantities of hazardous materials specified in Table 7.11.1 exceed the maximum allowable quantities in Table 25.3.1.1(1).

Such areas shall be provided with explosion (deflagration) venting, explosion (deflagration) prevention systems, or barricades in accordance with this section

and NFPA 69, or NFPA 495 as applicable. Deflagration venting shall not be utilized as a means to protect buildings from detonation hazards.

**7.11.2 Required deflagration venting.** Areas that are required to be provided with deflagration venting shall comply with the following:

1. Walls, ceilings and roofs exposing surrounding areas shall be designed to resist a minimum internal pressure of 4,788 Pa. The minimum internal design pressure shall not be less than five times the maximum internal relief pressure specified in Section 7.11.2, Item 5.
2. Deflagration venting shall be provided only in exterior walls and roofs.

**TABLE 7.11.1  
EXPLOSION CONTROL REQUIREMENTS**

MATERIAL	CLASS	EXPLOSION CONTROL METHODS	
		Barricade construction	Explosion (deflagration) venting or explosion (deflagration) prevention systems
Hazard Category			
Combustible dusts <sup>a</sup>	—	Not required	Required
Cryogenic fluids	Flammable	Not required	Required
Explosives	Division 1.1	Required	Not required
	Division 1.2	Required	Not required
	Division 1.3	Not required	Required
	Division 1.4	Not required	Required
	Division 1.5	Required	Not required
	Division 1.6	Required	Not required
Flammable gas	Gaseous	Not required	Required
	Liquefied	Not required	Required
Flammable liquids	IA <sup>b</sup>	Not required	Required
	IB <sup>c</sup>	Not required	Required
Organic peroxides	U	Required	Not permitted
	I	Required	Not permitted
Oxidizer liquids and solids	4	Required	Not permitted
Pyrophoric	Gases	Not required	Required
Unstable (reactive)	4	Required	Not permitted
	3 detonable	Required	Not permitted
	3 nondetonable	Not required	Required
Water-reactive liquids and solids	3	Not required	Required
	2 <sup>e</sup>	Not required	Required
Special Uses			
Acetylene generator rooms	—	Not required	Required
Grain processing	—	Not required	Required
Liquefied petroleum gas distribution facilities	—	Not required	Required
Where explosion hazards exist <sup>d</sup>	Detonation	Required	Not permitted
	Deflagration	Not required	Required

- a. Combustible dusts that are generated during manufacturing or processing. See definition of Combustible Dust in Chapter 1.
- b. Storage or use.
- c. In open use or dispensing.
- d. Rooms containing dispensing and use of hazardous materials when an explosive environment can occur because of the characteristics or nature of the hazardous materials or as a result of the dispensing or use process.
- e. A method of explosion control shall be provided when Class 2 water-reactive materials can form potentially explosive mixtures.

**Exception:** Where sufficient exterior wall and roof venting cannot be provided because of inadequate exterior wall or roof area, deflagration venting shall be allowed by specially designed shafts vented to the exterior of the building.

3. Deflagration venting shall be designed to prevent unacceptable structural damage. Where relieving a deflagration, vent closures shall not produce projectiles of sufficient velocity and mass to cause life threatening injuries to the occupants or other persons on the property or adjacent public ways.
4. The aggregate clear area of vents and venting devices shall be governed by the pressure resistance of the construction assemblies specified in Item 1 of this section and the maximum internal pressure allowed by Item 5 of this section.
5. Vents shall be designed to withstand loads in accordance with the SBC 301. Vents shall consist of any one or any combination of the following to relieve at a maximum internal pressure of 958 Pa, but not less than the loads required by the SBC 301:
  - 5.1 Exterior walls designed to release outward.
  - 5.2 Hatch covers.
  - 5.3 Outward swinging doors.
  - 5.4 Roofs designed to uplift.
  - 5.5 Venting devices listed for the purpose.
6. Vents designed to release from the exterior walls or roofs of the building when venting a deflagration shall discharge directly to the exterior of the building where an unoccupied space not less than 15.2 m in width is provided between the exterior walls of the building and the property line.
 

**Exception:** Vents complying with Item 7 of this section.
7. Vents designed to remain attached to the building when venting a deflagration shall be so located that the discharge opening shall not be less than 3 m vertically from window openings and exits in the building and 6.1 m horizontally from exits in the building, from window openings and exits in adjacent buildings on the same property, and from the property line.
8. Discharge from vents shall not be into the interior of the building.

**7.11.3 Explosion prevention systems.** Explosion prevention systems shall be of an approved type and installed in accordance with the provisions of these code requirements and NFPA 69.

**7.11.4 Barricades.** Barricades shall be designed and installed in accordance with NFPA 495.

## SECTION 7.12 CIVIL DEFENCE CONNECTIONS

**7.12.1 Installation.** Civil Defence connections shall be installed in accordance with the NFPA standards applicable to the system design.

**7.12.2 Location.** With respect to hydrants, driveways, buildings and landscaping, Civil Defence connections shall be so located that fire apparatus and hose connected to supply the system will not obstruct access to the buildings for other fire apparatus. The location of Civil Defence connections shall be approved.

**7.12.2.1 Visible location.** Civil Defence connections shall be located on the street side of buildings, fully visible and recognizable from the street or nearest point of Civil Defence vehicle access or as otherwise approved by the Building official.

- 7.12.2.2 Existing buildings.** On existing buildings, wherever the Civil Defence connection is not visible to approaching fire apparatus, the Civil Defence connection shall be indicated by an approved sign mounted on the street front or on the side of the building. Such sign shall have the letters “CDC” at least 150 mm high and words in letters at least 51 mm high or an arrow to indicate the location. All such signs shall be subject to the approval of the Building official.
- 7.12.3 Access.** Immediate access to fire department connections shall be maintained at all times and without obstruction by fences, bushes, trees, walls or any other object for a minimum of 1.0 m.
- 7.12.3.1 Locking Civil Defence connection caps.** The Building official is authorized to require locking caps on Civil Defence connections for water-based fire protection systems where the responding fire department carries appropriate key wrenches for removal.
- 7.12.4 Signs.** A metal sign with raised letters at least 25 mm in size shall be mounted on all Civil Defence connections serving fire sprinklers, standpipes or fire pump connections. Such signs shall read: AUTOMATIC SPRINKLERS or STANDPIPES or TEST CONNECTION or a combination thereof as applicable.
- 7.12.5 Backflow protection.** The potable water supply to automatic sprinkler and standpipe systems shall be protected against backflow as required by the SBC 701 and NFPA standards.
- 7.12.6 Inspection, testing and maintenance.** All Civil Defence connections shall be periodically inspected, tested and maintained in accordance with NFPA 25.

### SECTION 7.13 FIRE PUMPS

- 7.13.1 General.** Where provided, fire pumps shall be installed in accordance with this section and NFPA 20.
- 7.13.2 Protection against interruption of service.** The fire pump, driver, and controller shall be protected in accordance with NFPA 20 against possible interruption of service through damage caused by explosion, fire, flood, earthquake, rodents, insects, windstorm, freezing, vandalism and other adverse conditions.
- 7.13.3 Temperature of pump room.** Suitable means shall be provided for maintaining the temperature of a pump room or pump house, where required, above 5°C.
- 7.13.3.1 Engine manufacturer’s recommendation.** Temperature of the pump room, pump house or area where engines are installed shall never be less than the minimum recommended by the engine manufacturer. The engine manufacturer’s recommendations for oil heaters shall be followed.
- 7.13.4 Valve supervision.** Where provided, the fire pump suction, discharge and bypass valves, and the isolation valves on the backflow prevention device or assembly shall be supervised open by one of the following methods:
1. Central-station, proprietary, or remote-station signaling service.
  2. Local signaling service that will cause the sounding of an audible signal at a constantly attended location.



3. Locking valves open.
4. Sealing of valves and approved weekly recorded inspection where valves are located within fenced enclosures under the control of the owner.

- 7.13.5 Testing and maintenance.** Fire pumps shall be inspected, tested and maintained in accordance with the requirements of this section and NFPA 25.
- 7.13.5.1 Acceptance test.** Acceptance testing shall be done in accordance with the requirements of NFPA 20.
- 7.13.5.2 Generator sets.** Engine generator sets supplying emergency or standby power to fire pump assemblies shall be periodically tested in accordance with NFPA 110.
- 7.13.5.3 Transfer switches.** Automatic transfer switches shall be periodically tested in accordance with NFPA 110.
- 7.13.5.4 Pump room environmental conditions.** Tests of pump room environmental conditions, including heating, ventilation and illumination shall be made to ensure proper manual or automatic operation of the associated equipment.



## CHAPTER 8 MEANS OF EGRESS

### SECTION 8.1 GENERAL

- 8.1.1 General.** Buildings or portions thereof shall be provided with a means of egress system as required by this chapter. The provisions of this chapter shall control the design, construction and arrangement of means of egress components required to provide an approved means of egress from structures and portions thereof. Sections 8.3 through 8.25 shall apply to new construction. Sections 8.26 and 8.27 shall apply to existing buildings.  
**Exception:** Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three stories above grade plane in height with a separate means of egress and their accessory structures shall not be considered in this Chapter.
- 8.1.2 Minimum requirements.** It shall be unlawful to alter a building or structure in a manner that will reduce the number of exits or the capacity of the means of egress to less than required by these code requirements.

### SECTION 8.2 DEFINITIONS

- 8.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**ACCESSIBLE MEANS OF EGRESS.** A continuous and unobstructed way of egress travel from any point in a building or facility that provides an accessible route to an area of refuge, a horizontal exit or a public way.

**AISLE ACCESSWAY.** That portion of an exit access that leads to an aisle.

**ALTERNATING TREAD DEVICE.** A device that has a series of steps between 50 and 70 degrees (0.87 and 1.22 rad) from horizontal, usually attached to a center support rail in an alternating manner so that the user does not have both feet on the same level at the same time.

**AREA OF REFUGE.** An area where persons unable to use stairways can remain temporarily to await instructions or assistance during emergency evacuation.

**BLEACHERS.** Tiered seating facilities.

**COMMON PATH OF EGRESS TRAVEL.** That portion of exit access which the occupants are required to traverse before two separate and distinct paths of egress travel to two exits are available. Paths that merge are common paths of travel. Common paths of egress travel shall be included within the permitted travel distance.

**CORRIDOR.** An enclosed exit access component that defines and provides a path of egress travel to an exit.

**DOOR, BALANCED.** A door equipped with double-pivoted hardware so designed as to cause a semicounter balanced swing action when opening.

**EGRESS COURT.** A court or yard which provides access to a public way for one or more exits.

**EMERGENCY ESCAPE AND RESCUE OPENING.** An operable window, door or other similar device that provides for a means of escape and access for rescue in the event of an emergency.

**EXIT.** That portion of a means of egress system which is separated from other interior spaces of a building or structure by fire-resistance-rated construction and opening protectives as required to provide a protected path of egress travel between the exit access and the exit discharge. Exits include exterior exit doors at ground level, exit enclosures, exit passageways, exterior exit stairs, exterior exit ramps and horizontal exits.

**EXIT ACCESS.** That portion of a means of egress system that leads from any occupied portion of a building or structure to an exit.

**EXIT DISCHARGE.** That portion of a means of egress system between the termination of an exit and a public way.

**EXIT DISCHARGE, LEVEL OF.** The horizontal plane located at the point at which an exit terminates and an exit discharge begins.

**EXIT ENCLOSURE.** An exit component that is separated from other interior spaces of a building or structure by fire-resistance-rated construction and opening protectives, and provides for a protected path of egress travel in a vertical or horizontal direction to the exit discharge or the public way.

**EXIT, HORIZONTAL.** A path of egress travel from one building to an area in another building on approximately the same level, or a path of egress travel through or around a wall or partition to an area on approximately the same level in the same building, which affords safety from fire and smoke from the area of incidence and areas communicating therewith.

**EXIT PASSAGEWAY.** An exit component that is separated from all other interior spaces of a building or structure by fire-resistance-rated construction and opening protectives, and provides for a protected path of egress travel in a horizontal direction to the exit discharge or the public way.

**FIRE EXIT HARDWARE.** Panic hardware that is listed for use on fire door assemblies.

**FLOOR AREA, GROSS.** The floor area within the inside perimeter of the exterior walls of the building under consideration, exclusive of vent shafts and courts, without deduction for corridors, stairways, closets, the thickness of interior

walls, columns or other features. The floor area of a building, or portion thereof, not provided with surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above. The gross floor area shall not include shafts with no openings or interior courts.

**FLOOR AREA, NET.** The actual occupied area not including unoccupied accessory areas such as corridors, stairways, toilet rooms, mechanical rooms and closets.

**FOLDING AND TELESCOPIC SEATING.** Tiered seating facilities having an overall shape and size that are capable of being reduced for purposes of moving or storing.

**GRANDSTAND.** Tiered seating facilities.

**GUARD.** A building component or a system of building components located at or near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to a lower level.

**HANDRAIL.** A horizontal or sloping rail intended for grasping by the hand for guidance or support.

**MEANS OF EGRESS.** A continuous and unobstructed path of vertical and horizontal egress travel from any occupied portion of a building or structure to a public way. A means of egress consists of three separate and distinct parts: the exit access, the exit and the exit discharge.

**NOSING.** The leading edge of treads of stairs and of landings at the top of stairway flights.

**OCCUPANT LOAD.** The number of persons for which the means of egress of a building or portion thereof is designed.

**PANIC HARDWARE.** A door-latching assembly incorporating a device that releases the latch upon the application of a force in the direction of egress travel.

**PUBLIC WAY.** A street, alley or other parcel of land open to the outside air leading to a street, that has been deeded, dedicated or otherwise permanently appropriated to the public for public use and which has a clear width and height of not less than 3.1 m.

**RAMP.** A walking surface that has a running slope steeper than one unit vertical in 20 units horizontal (5 percent slope).

**SCISSOR STAIR.** Two interlocking stairways providing two separate paths of egress located within one stairwell enclosure.

**SMOKE-PROTECTED ASSEMBLY SEATING.** Seating served by means of egress that is not subject to smoke accumulation within or under a structure.

**STAIR.** A change in elevation, consisting of one or more risers.

**STAIRWAY.** One or more flights of stairs, either exterior or interior, with the necessary landings and platforms connecting them, to form a continuous and uninterrupted passage from one level to another.

**STAIRWAY, EXTERIOR.** A stairway that is open on at least one side, except for required structural columns, beams, handrails and guards. The adjoining open areas shall be either yards, courts or public ways. The other sides of the exterior stairway need not be open.

**STAIRWAY, INTERIOR.** A stairway not meeting the definition of an exterior stairway.

**STAIRWAY, SPIRAL.** A stairway having a closed circular form in its plan view with uniform section-shaped treads attached to and radiating from a minimum-diameter supporting column.

**WINDER.** A tread with nonparallel edges.

### SECTION 8.3 GENERAL MEANS OF EGRESS

**8.3.1 Applicability.** The general requirements specified in Sections 8.3 through 8.12 shall apply to all three elements of the means of egress system, in addition to those specific requirements for the exit access, the exit and the exit discharge detailed elsewhere in this chapter.

**8.3.2 Ceiling height.** The means of egress shall have a ceiling height of not less than 2.1 m.

**Exceptions:**

1. Sloped ceilings in accordance with Section 7.8.2 of the SBC 201.
2. Ceilings of dwelling units and sleeping units within residential occupancies in accordance with Section 7.8.2 of the SBC 201.
3. Allowable projections in accordance with Section 8.3.3.
4. Stair headroom in accordance with Section 8.9.2.
5. Door height in accordance with Section 8.8.1.1.

**8.3.3 Protruding objects.** Protruding objects shall comply with the requirements of Sections 8.3.3.1 through 8.3.3.4.

**8.3.3.1 Headroom.** Protruding objects are permitted to extend below the minimum ceiling height required by Section 8.3.2 provided a minimum headroom of 2 m shall be provided for any walking surface, including walks, corridors, aisles and passageways. Not more than 50 percent of the ceiling area of a means of egress shall be reduced in height by protruding objects.

**Exception:** Door closers and stops shall not reduce headroom to less than 2.0 m. A barrier shall be provided where the vertical clearance is less than 2.1 m high. The leading edge of such a barrier shall be located 685 mm maximum above the floor.

**8.3.3.2 Free-standing objects.** A free-standing object mounted on a post or pylon shall not overhang that post or pylon more than 300 mm where the lowest point of the leading edge is more than 685 mm and less than 2.1 m above the walking surface. Where a sign or other obstruction is mounted between posts or pylons and the clear distance between the posts or pylons is greater than 300 mm, the lowest edge

of such sign or obstruction shall be 685 mm maximum or 2.1 m minimum above the finish floor or ground.

**Exception:** This requirement shall not apply to sloping portions of handrails serving stairs and ramps.

- 8.3.3.3 Horizontal projections.** Structural elements, fixtures or furnishings shall not project horizontally from either side more than 100 mm over any walking surface between the heights of 685 mm and 2 m above the walking surface.

**Exception:** Handrails serving stairs and ramps are permitted to protrude 114 mm from the wall.

- 8.3.3.4 Clear width.** Protruding objects shall not reduce the minimum clear width of accessible routes as required in Section 9.4 of the SBC 201.

- 8.3.4 Floor surface.** Walking surfaces of the means of egress shall have a slip-resistant surface and be securely attached.

- 8.3.5 Elevation change.** Where changes in elevation of less than 300 mm exist in the means of egress, sloped surfaces shall be used. Where the slope is greater than one unit vertical in 20 units horizontal (5 percent slope), ramps complying with Section 8.10 shall be used. Where the difference in elevation is 150 mm or less, the ramp shall be equipped with either handrails or floor finish materials that contrast with adjacent floor finish materials.

**Exceptions:**

1. A single step with a maximum riser height of 180 mm is permitted for buildings with occupancies in Groups F, H, R-2 and R-3 as applicable in Chapter 2, and Groups S and U at exterior doors not required to be accessible by Chapter 9 of the SBC 201.
2. A stair with a single riser or with two risers and a tread is permitted at locations not required to be accessible by Chapter 9 of the SBC 201, provided that the risers and treads comply with Section 8.9.3, the minimum depth of the tread is 330 mm and at least one handrail complying with Section 8.9.11 is provided within 760 mm of the centerline of the normal path of egress travel on the stair.
3. An aisle serving seating that has a difference in elevation less than 300 mm is permitted at locations not required to be accessible by Chapter 9 of the SBC 201, provided that the risers and treads comply with Section 8.24.11 and the aisle is provided with a handrail complying with Section 8.24.13.

Any change in elevation in a corridor serving nonambulatory persons in a Group I-2 occupancy shall be by means of a ramp or sloped walkway.

- 8.3.6 Means of egress continuity.** The path of egress travel along a means of egress shall not be interrupted by any building element other than a means of egress component as specified in this chapter. Obstructions shall not be placed in the required width of a means of egress except projections permitted by this shall not be diminished along the path of egress travel.

- 8.3.7 Elevators, escalators and moving walks.** Elevators, escalators and moving walks shall not be used as a component of a required means of egress from any other part of the building.

**Exception:** Elevators used as an accessible means of egress in accordance with Section 8.7.4.

## SECTION 8.4 OCCUPANT LOAD

- 8.4.1 Design occupant load.** In determining means of egress requirements, the number of occupants for whom means of egress facilities shall be provided shall be established by the largest number computed in accordance with Sections 8.4.1.1 through 8.4.1.3.
- 8.4.1.1 Actual number.** The actual number of occupants for whom each occupied space, floor or building is designed.
- 8.4.1.2 Number by Table 8.4.1.2.** The number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 8.4.1.2.
- 8.4.1.3 Number by combination.** Where occupants from accessory spaces egress through a primary area, the calculated occupant load for the primary space shall include the total occupant load of the primary space plus the number of occupants egressing through it from the accessory space.
- 8.4.2 Increased occupant load.** The occupant load permitted in any building or portion thereof is permitted to be increased from that number established for the occupancies in Table 8.4.1.2 provided that all other requirements of the code are also met based on such modified number and the occupant load shall not exceed one occupant per  $0.47 \text{ m}^2$  of occupiable floor space. Where required by the building code official, an approved aisle, seating or fixed equipment diagram substantiating any increase in occupant load shall be submitted. Where required by the building code official, such diagram shall be posted.
- 8.4.3 Posting of occupant load.** Every room or space that is an assembly occupancy shall have the occupant load of the room or space posted in a conspicuous place, near the main exit or exit access doorway from the room or space. Posted signs shall be of an approved legible permanent design and shall be maintained by the owner or authorized agent.
- 8.4.4 Exiting from multiple levels.** Where exits serve more than one floor, only the occupant load of each floor considered individually shall be used in computing the required capacity of the exits at that floor, provided that the exit capacity shall not decrease in the direction of egress travel.
- 8.4.5 Egress convergence.** Where means of egress from floors above and below converge at an intermediate level, the capacity of the means of egress from the point of convergence shall not be less than the sum of the two floors.
- 8.4.6 Mezzanine levels.** The occupant load of a mezzanine level with egress onto a room or area below shall be added to that room or area's occupant load, and the capacity of the exits shall be designed for the total occupant load thus established.
- 8.4.7 Fixed seating.** For areas having fixed seats and aisles, the occupant load shall be determined by the number of fixed seats installed therein.  
For areas having fixed seating without dividing arms, the occupant load shall not be less than the number of seats based on one person for each 450 mm of seating length.  
The occupant load of seating booths shall be based on one person for each 600 mm of booth seat length measured at the backrest of the seating booth.



**TABLE 8.4.1.2**  
**MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

<b>OCCUPANCY</b>	<b>FLOOR AREA IN SQ. METER. PER OCCUPANT</b>
Agricultural building	28 gross
Aircraft hangars	47 gross
Airport terminal	
Baggage claim	1.9 gross
Baggage handling	28 gross
Concourse	9.3 gross
Waiting areas	1.4 gross
Assembly	
Gaming floors (keno, slots, etc.)	1 gross
Assembly with fixed seats	See Section 8.3.2.2.9
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	0.65 net
Standing space	0.47 net
Unconcentrated (tables and chairs)	1.4 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	0.65 net
Business areas	9.3 gross
Courtrooms—other than fixed seating areas	3.7 net
Dormitories	4.7 gross
Educational	
Classroom area	1.9 net
Shops and other vocational room areas	4.7 net
Exercise rooms	4.7 gross
H-5 Fabrication and manufacturing areas	18.6 gross
Industrial areas	9.3 gross
Institutional areas	
Inpatient treatment areas	22.3 gross
Outpatient areas	9.3 gross
Sleeping areas	11.2 gross
Kitchens, commercial	18.6 gross
Library	
Reading rooms	4.7 net
Stack area	9.3 gross
Locker rooms	4.7 gross
Mercantile	
Areas on other floors	5.6 gross
Basement and grade floor areas	2.8 gross
Storage, stock, shipping areas	28 gross
Parking garages	18.6 gross
Residential	18.6 gross
Skating rinks, swimming pools	
Rink and pool	4.7 gross
Decks	1.4 gross
Stages and platforms	1.4 net
Accessory storage areas, mechanical equipment room	28 gross
Warehouses	47 gross

- 8.4.8 Outdoor areas.** Yards, patios, courts and similar outdoor areas accessible to and usable by the building occupants shall be provided with means of egress as required by this chapter. The occupant load of such outdoor areas shall be assigned by the building code official in accordance with the anticipated use. Where outdoor areas are to be used by persons in addition to the occupants of the building, and the path of egress travel from the outdoor areas passes through the building, means of egress requirements for the building shall be based on the sum of the occupant loads of the building plus the outdoor areas.

**Exceptions:**

1. Outdoor areas used exclusively for service of the building need only have one means of egress.
2. Both outdoor areas associated with Group R-3 and individual dwelling units of Group R-2, as applicable in Section 8.1.1.

- 8.4.9 Multiple occupancies.** Where a building contains two or more occupancies, the means of egress requirements shall apply to each portion of the building based on the occupancy of that space. Where two or more occupancies utilize portions of the same means of egress system, those egress components shall meet the more stringent requirements of all occupancies that are served.

## SECTION 8.5 EGRESS WIDTH

- 8.5.1 Minimum required egress width.** The means of egress width shall not be less than required by this section. The total width of means of egress in millimeters shall not be less than the total occupant load served by the means of egress multiplied by the factors in Table 8.5.1 and not less than specified elsewhere in these code requirements. Multiple means of egress shall be sized such that the loss of any one means of egress shall not reduce the available capacity to less than 50 percent of the required capacity. The maximum capacity required from any story of a building shall be maintained to the termination of the means of egress.

**Exception:** Means of egress complying with Section 8.24.

**TABLE 8.5.1  
EGRESS WIDTH PER OCCUPANT SERVED**

OCCUPANCY	WITHOUT SPRINKLER SYSTEM		WITH SPRINKLER SYSTEM <sup>a</sup>	
	Stairways (mm per occupant)	Other egress components (mm per occupant)	Stairways (mm per occupant)	Other egress components (mm per occupant)
Occupancies other than those listed below	7.6	5.1	5.1	3.8
Hazardous: H-1, H-2, H-3 and H-4	17.8	10.2	7.6	5.1
Institutional: I-2	Not Applicable	Not Applicable	7.6	5.1

- a. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

- 8.5.2 Door encroachment.** Doors opening into the path of egress travel shall not reduce the required width to less than one-half during the course of the swing. When fully open, the door shall not project more than 180 mm into the required width.

**Exception:** The restrictions on a door swing shall not apply to doors within individual dwelling units and sleeping units of Group R-2 and dwelling units of Group R-3.

## SECTION 8.6 MEANS OF EGRESS ILLUMINATION

**8.6.1 Illumination required.** The means of egress, including the exit discharge, shall be illuminated at all times the building space served by the means of egress is occupied.

**Exceptions:**

1. Occupancies in Group U.
2. Aisle accessways in Group A.
3. Dwelling units and sleeping units in Groups R-1, R-2 and R-3.
4. Sleeping units of Group I occupancies.

**8.6.2 Illumination level.** The means of egress illumination level shall not be less than 11 lux at the floor level.

**Exception:** For auditoriums, theaters, concert or opera halls and similar assembly occupancies, the illumination at the floor level is permitted to be reduced during performances to not less than 2.15 lux provided that the required illumination is automatically restored upon activation of a premise's fire alarm system where such system is provided.

**8.6.3 Illumination emergency power.** The power supply for means of egress illumination shall normally be provided by the premise's electrical supply. In the event of power supply failure, an emergency electrical system shall automatically illuminate the following areas:

1. Exit access corridors, passageways and aisles in rooms and spaces which require two or more means of egress.
2. Exit access corridors and exit stairways located in buildings required to have two or more exits.
3. Exterior egress components at other than the level of exit discharge until exit discharge is accomplished for buildings required to have two or more exits.
4. Interior exit discharge elements, as permitted in Section 8.23.1, in buildings required to have two or more exits.
5. The portion of the exterior exit discharge immediately adjacent to exit discharge doorways in buildings required to have two or more exits.

The emergency power system shall provide power for a duration of not less than 90 minutes and shall consist of storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with Section 5D.4.

**8.6.4 Performance of system.** Emergency lighting facilities shall be arranged to provide initial illumination that is at least an average of 11 lux and a minimum at any point of 1 lux measured along the path of egress at floor level. Illumination levels shall be permitted to decline to 6 lux average and a minimum at any point of 0.6 lux at the end of the emergency lighting time duration. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.

## SECTION 8.7

### ACCESSIBLE MEANS OF EGRESS

- 8.7.1 Accessible means of egress required.** Accessible means of egress shall comply with this section. Accessible spaces shall be provided with not less than one accessible means of egress. Where more than one means of egress is required by Section 8.14.1 or 8.18.1 from any accessible space, each accessible portion of the space shall be served by not less than two accessible means of egress.

**Exceptions:**

1. Accessible means of egress are not required in alterations to existing buildings.
2. One accessible means of egress is required from an accessible mezzanine level in accordance with Section 8.7.3 or 8.7.4.
3. In assembly spaces with sloped floors, one accessible means of egress is required from a space where the common path of travel of the accessible route for access to the wheelchair spaces meets the requirements in Section 8.24.9.

- 8.7.2 Continuity and components.** Each required accessible means of egress shall be continuous to a public way and shall consist of one or more of the following components:

1. Accessible routes complying with Section 9.4 of the SBC 201.
2. Stairways within exit enclosures complying with Sections 8.7.3 and 8.19.1.
3. Elevators complying with Section 8.7.4.
4. Platform lifts complying with Section 8.7.5.
5. Horizontal exits.
6. Smoke barriers.

**Exceptions:**

1. Where the exit discharge is not accessible, an exterior area for assisted rescue must be provided in accordance with Section 8.7.8.
2. Where the exit stairway is open to the exterior, the accessible means of egress shall include either an area of refuge in accordance with Section 8.7.6 or an exterior area for assisted rescue in accordance with Section 8.7.8.

- 8.7.2.1 Buildings with four or more stories.** In buildings where a required accessible floor is four or more stories above or below a level of exit discharge, at least one required accessible means of egress shall be an elevator complying with Section 8.7.4.

**Exceptions:**

1. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, the elevator shall not be required on floors provided with a horizontal exit and located at or above the level of exit discharge.
2. In buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, the elevator shall not be required on floors provided with a ramp conforming to the provisions of Section 8.10.

- 8.7.3 Enclosed exit stairways.** An enclosed exit stairway, to be considered part of an accessible means of egress, shall have a clear width of 1.2 m minimum between handrails and shall either incorporate an area of refuge within an enlarged floor-level landing or shall be accessed from either an area of refuge complying with Section 8.7.6 or a horizontal exit.

**Exceptions:**

1. Open exit stairways as permitted by Section 8.19.1 are permitted to be considered part of an accessible means of egress.
2. The area of refuge is not required at open stairways that are permitted by Section 8.19.1 in buildings or facilities that are equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
3. The clear width of 1.2 m between handrails and the area of refuge is not required at exit stairways in buildings or facilities equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.
4. The clear width of 1.2 m between handrails is not required for enclosed exit stairways accessed from a horizontal exit.
5. Areas of refuge are not required at exit stairways serving open parking garages.

**8.7.4 Elevators.** An elevator to be considered part of an accessible means of egress shall comply with the emergency operation and signaling device requirements of Section 2.27 of ASME A17.1. Standby power shall be provided in accordance with SBC 401 and 501. The elevator shall be accessed from either an area of refuge complying with Section 8.7.6 or a horizontal exit.

**Exceptions:**

1. Elevators are not required to be accessed from an area of refuge or horizontal exit in open parking garages.
2. Elevators are not required to be accessed from an area of refuge or horizontal exit in buildings and facilities equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

**8.7.5 Platform lifts.** Platform (wheelchair) lifts shall not serve as part of an accessible means of egress, except where allowed as part of a required accessible route in Section 9.9.7 of the SBC 201. Platform lifts in accordance with SBC 401 shall be installed in accordance with ASME A18.1. Standby power shall be provided in accordance with Section 5D.4.2 for platform lifts permitted to serve as part of a means of egress.

**8.7.6 Areas of refuge.** Every required area of refuge shall be accessible from the space it serves by an accessible means of egress. The maximum travel distance from any accessible space to an area of refuge shall not exceed the travel distance permitted for the occupancy in accordance with Section 8.15.1. Every required area of refuge shall have direct access to an enclosed stairway complying with Sections 8.7.3 and 8.19.1 or an elevator complying with Section 8.7.4. Where an elevator lobby is used as an area of refuge, the shaft and lobby shall comply with Section 8.19.1.8 for smokeproof enclosures except where the elevators are in an area of refuge formed by a horizontal exit or smoke barrier.

**8.7.6.1 Size.** Each area of refuge shall be sized to accommodate one wheelchair space of 760 mm by 1200 mm for each 200 occupants or portion thereof, based on the occupant load of the area of refuge and areas served by the area of refuge. Such wheelchair spaces shall not reduce the required means of egress width. Access to any of the required wheelchair spaces in an area of refuge shall not be obstructed by more than one adjoining wheelchair space.

**8.7.6.2 Separation.** Each area of refuge shall be separated from the remainder of the story by a smoke barrier complying with Section 4B.9. Each area of refuge shall be designed to minimize the intrusion of smoke.

**Exceptions:**

1. Areas of refuge located within a stairway enclosure.
2. Areas of refuge where the area of refuge and areas served by the area of refuge are equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.

**8.7.6.3 Two-way communication.** Areas of refuge shall be provided with a two-way communication system between the area of refuge and a central control point. If the central control point is not constantly attended, the area of refuge shall also have controlled access to a public telephone system. Location of the central control point shall be approved by the Civil Defense. The two-way communication system shall include both audible and visible signals.

**8.7.6.4 Instructions.** In areas of refuge that have a two-way emergency communications system, instructions on the use of the area under emergency conditions shall be posted adjoining the communications system. The instructions shall include all of the following:

1. Directions to find other means of egress.
2. Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
3. Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.
4. Directions for use of the emergency communications system.

**8.7.6.5 Identification.** Each door providing access to an area of refuge from an adjacent floor area shall be identified by a sign complying with ICC A117.1 stating: AREA OF REFUGE, and including the Saudi Symbol of Accessibility. Where exit sign illumination is required by Section 8.11.2, the area of refuge sign shall be illuminated. Additionally, tactile signage complying with ICC A117.1 shall be located at each door to an area of refuge.

**8.7.7 Signage.** At exits and elevators serving a required accessible space but not providing an approved accessible means of egress, signage shall be installed indicating the location of accessible means of egress.

**8.7.8 Exterior area for assisted rescue.** The exterior area for assisted rescue must be open to the outside air and meet the requirements of Section 8.7.6.1. Separation walls shall comply with the requirements of Section 4B.4 for exterior walls. Where walls or openings are between the area for assisted rescue and the interior of the building, the building exterior walls within 3.1 m horizontally of a nonrated wall or unprotected opening shall be constructed as required for a minimum 1-hour fire-resistance rating with  $3/4$ -hour opening protectives. This construction shall extend vertically from the ground to a point 3.1 m above the floor level of the area for assisted rescue or to the roof line, whichever is lower.

**8.7.8.1 Openness.** The exterior area for assisted rescue shall be at least 50 percent open, and the open area above the guards shall be so distributed as to minimize the accumulation of smoke or toxic gases.

**8.7.8.2 Exterior exit stairway.** Exterior exit stairways that are part of the means of egress for the exterior area for assisted rescue shall provide a clear width of 1.2 m between handrails.

- 8.7.8.3 Identification.** Exterior areas for assisted rescue shall have identification as required for area of refuge that complies with Section 8.7.6.5.

## SECTION 8.8

### DOORS, GATES AND TURNSTILES

- 8.8.1 Doors.** Means of egress doors shall meet the requirements of this section. Doors serving a means of egress system shall meet the requirements of this section and Section 8.17.2. Doors provided for egress purposes in numbers greater than required by these code requirements shall meet the requirements of this section. Means of egress doors shall be readily distinguishable from the adjacent construction and finishes such that the doors are easily recognizable as doors. Mirrors or similar reflecting materials shall not be used on means of egress doors. Means of egress doors shall not be concealed by curtains, drapes, decorations or similar materials.

- 8.8.1.1 Size of doors.** The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 800 mm. Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees (1.57 rad). Where this section requires a minimum clear width of 800 mm and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 800 mm. The maximum width of a swinging door leaf shall be 1.2 m nominal. Means of egress doors in an occupancy in Group I-2 used for the movement of beds shall provide a clear width not less than 1.1 m. The height of doors shall not be less than 2.1 m.

**Exceptions:**

1. The minimum and maximum width shall not apply to door openings that are not part of the required means of egress in occupancies in Groups R-2 and R-3 as applicable in Chapter 2.
2. Door openings to resident sleeping units in occupancies in Group I-3 shall have a clear width of not less than 710 mm.
3. Door openings to storage closets less than 0.9 m<sup>2</sup> in area shall not be limited by the minimum width.
4. Width of door leaves in revolving doors that comply with Section 8.8.1.3.1 shall not be limited.
5. Door openings within a dwelling unit or sleeping unit shall not be less than 2.0 m in height.
6. Exterior door openings in dwelling units and sleeping units, other than the required exit door, shall not be less than 2.0 m in height.
7. Interior egress doors within a dwelling unit or sleeping unit which is not required to be adaptable or accessible.
8. Door openings required to be accessible within Type B dwelling units shall have a minimum clear width of 800 mm.

- 8.8.1.1.1 Projections into clear width.** There shall not be projections into the required clear width lower than 860 mm above the floor or ground. Projections into the clear opening width between 860 mm and 2.1 m above the floor or ground shall not exceed 100 mm.

- 8.8.1.2 Door swing.** Egress doors shall be side-hinged swinging.

**Exceptions:**

1. Private garages, office areas, factory and storage areas with an occupant load of 10 or less.

2. Group I-3 occupancies used as a place of detention.
3. Doors within or serving a single dwelling unit in Groups R-2 and R-3 as applicable in Chapter 2.
4. In other than Group H occupancies, revolving doors complying with Section 8.8.1.3.1.
5. In other than Group H occupancies, horizontal sliding doors complying with Section 8.8.1.3.3 are permitted in a means of egress.
6. Power-operated doors in accordance with Section 8.8.1.3.1.

Doors shall swing in the direction of egress travel where serving an occupant load of 50 or more persons or a Group H occupancy.

The opening force for interior side-swinging doors without closers shall not exceed a 22 N force. For other side-swinging, sliding and folding doors, the door latch shall release when subjected to a 67 N force. The door shall be set in motion when subjected to a 133 N force. The door shall swing to a full-open position when subjected to a 67 N force. Forces shall be applied to the latch side.

**8.8.1.3 Special doors.** Special doors and security grilles shall comply with the requirements of Sections 8.8.1.3.1 through 8.8.1.3.5.

**8.8.1.3.1 Revolving doors.** Revolving doors shall comply with the following:

1. Each revolving door shall be capable of collapsing into a bookfold position with parallel egress paths providing an aggregate width of 900 mm.
2. A revolving door shall not be located within 3.1 m of the foot of or top of stairs or escalators. A dispersal area shall be provided between the stairs or escalators and the revolving doors.
3. The revolutions per minute (rpm) for a revolving door shall not exceed those shown in Table 8.8.1.3.1.
4. Each revolving door shall have a side-hinged swinging door which complies with Section 8.8.1 in the same wall and within 3.1 m of the revolving door.

**TABLE 8.8.1.3.1  
REVOLVING DOOR SPEEDS**

<b>INSIDE DIAMETER (mm)</b>	<b>POWER-DRIVEN- TYPE SPEED CONTROL (rpm)</b>	<b>MANUAL-TYPE SPEED CONTROL (rpm)</b>
1,980	11	12
2,130	10	11
2,290	9	11
2,440	9	10
2,590	8	9
2,740	8	9
2,896	7	8
3,050	7	8

**8.8.1.3.1.1 Egress component.** A revolving door used as a component of a means of egress shall comply with Section 8.8.1.3.1 and the following three conditions:

1. Revolving doors shall not be given credit for more than 50 percent of the required egress capacity.
2. Each revolving door shall be credited with no more than a 50-person capacity.
3. Each revolving door shall be capable of being collapsed when a force of not more than 578 N is applied within 76 mm of the outer edge of a wing.



**8.8.1.3.1.2 Other than egress component.** A revolving door used as other than a component of a means of egress shall comply with Section 8.8.1.3.1. The collapsing force of a revolving door not used as a component of a means of egress shall not be more than 801 N.

**Exception:** A collapsing force in excess of 801 N is permitted if the collapsing force is reduced to not more than 578 N when at least one of the following conditions is satisfied:

1. There is a power failure or power is removed to the device holding the door wings in position.
2. There is an actuation of the automatic sprinkler system where such system is provided.
3. There is an actuation of a smoke detection system which is installed in accordance with Section 7.7 to provide coverage in areas within the building which are within 23.0 m of the revolving doors.
4. There is an actuation of a manual control switch, in an approved location and clearly defined, which reduces the holding force to below the 578 N force level.

**8.8.1.3.2 Power-operated doors.** Where means of egress doors are operated by power, such as doors with a photoelectric-actuated mechanism to open the door upon the approach of a person, or doors with power-assisted manual operation, the design shall be such that in the event of power failure, the door is capable of being opened manually to permit means of egress travel or closed where necessary to safeguard means of egress. The forces required to open these doors manually shall not exceed those specified in Section 8.8.1.2, except that the force to set the door in motion shall not exceed 220 N. The door shall be capable of swinging from any position to the full width of the opening in which such door is installed when a force is applied to the door on the side from which egress is made. Full-power-operated doors shall comply with BHMA A156.19. Power-assisted and low-energy doors shall comply with BHMA A156.19.

**Exceptions:**

1. Occupancies in Group I-3.
2. Horizontal sliding doors complying with Section 8.8.1.3.3.
3. For a biparting door in the emergency breakout mode, a door leaf located within a multiple-leaf opening shall be exempt from the minimum 800 mm single-leaf requirement of Section 8.8.1.1, provided a minimum 800 mm clear opening is provided when the two biparting leaves meeting in the center are broken out.

**8.8.1.3.3 Horizontal sliding doors.** In other than Group H occupancies, horizontal sliding doors permitted to be a component of a means of egress in accordance with Exception 5 to Section 8.8.1.2 shall comply with all of the following criteria:

1. The doors shall be power operated and shall be capable of being operated manually in the event of power failure.
2. The doors shall be openable by a simple method from both sides without special knowledge or effort.
3. The force required to operate the door shall not exceed 133 N to set the door in motion and 67 N to close the door or open it to the minimum required width.
4. The door shall be openable with a force not to exceed 67 N when a force of 1,100 N is applied perpendicular to the door adjacent to the operating device.

5. The door assembly shall comply with the applicable fire protection rating and, where rated, shall be self closing or automatic-closing by smoke detection, shall be installed in accordance with NFPA 80 and shall comply with Section 4B.15.
6. The door assembly shall have an integrated standby power supply.
7. The door assembly power supply shall be electrically supervised.
8. The door shall open to the minimum required width within 10 seconds after activation of the operating device.

**8.8.1.3.4 Access-controlled egress doors.** The entrance doors in a means of egress in buildings with an occupancy in Group A, B, E, M, R-1 or R-2 and entrance doors to tenant spaces in occupancies in Groups A, B, E, M, R-1 and R-2 are permitted to be equipped with an approved entrance and egress access control system which shall be installed in accordance with all of the following criteria:

1. A sensor shall be provided on the egress side arranged to detect an occupant approaching the doors. The doors shall be arranged to unlock by a signal from or loss of power to the sensor.
2. Loss of power to that part of the access control system which locks the doors shall automatically unlock the doors.
3. The doors shall be arranged to unlock from a manual unlocking device located 1.0 m to 1.2 m vertically above the floor and within 1.5 m of the secured doors. Ready access shall be provided to the manual unlocking device and the device shall be clearly identified by a sign that reads: PUSH TO EXIT. When operated, the manual unlocking device shall result in direct interruption of power to the lock—independent of the access control system electronics and the doors shall remain unlocked for a minimum of 30 seconds.
4. Activation of the building fire alarm system, if provided, shall automatically unlock the doors, and the doors shall remain unlocked until the fire alarm system has been reset.
5. Activation of the building automatic sprinkler or fire detection system, if provided, shall automatically unlock the doors. The doors shall remain unlocked until the fire alarm system has been reset.
6. Entrance doors in buildings with an occupancy in Group A, B, E or M shall not be secured from the egress side during periods that the building is open to the general public.

**8.8.1.3.5 Security grilles.** In Groups B, F, M and S, horizontal sliding or vertical security grilles are permitted at the main exit and shall be openable from the inside without the use of a key or special knowledge or effort during periods that the space is occupied. The grilles shall remain secured in the full-open position during the period of occupancy by the general public. Where two or more means of egress are required, not more than one-half of the exits or exit access doorways shall be equipped with horizontal sliding or vertical security grilles.

**8.8.1.4 Floor elevation.** There shall be a floor or landing on each side of a door. Such floor or landing shall be at the same elevation on each side of the door. Landings shall be level except for exterior landings, which are permitted to have a slope not to exceed 0.25 unit vertical in 12 units horizontal (2 percent slope).

**Exceptions:**

1. Doors serving individual dwelling units in Groups R-2 and R-3 as applicable in Section 8.1.1 where the following apply:
  - 1.1 A door is permitted to open at the top step of an interior flight of stairs, provided the door does not swing over the top step.

1.2 Screen doors and storm doors are permitted to swing over stairs or landings.

2. Exterior doors as provided for in Section 8.3.5, Exception 1, and Section 8.17.2, which are not on an accessible route.
3. In Group R-3 occupancies, the landing at an exterior doorway shall not be more than 200 mm below the top of the threshold, provided the door, other than an exterior storm or screen door, does not swing over the landing.
4. Variations in elevation due to differences in finish materials, but not more than 12.7 mm.
5. Exterior decks, patios or balconies that are part of Type B dwelling units and have impervious surfaces, and that are not more than 100 mm below the finished floor level of the adjacent interior space of the dwelling unit.

**8.8.1.5 Landings at doors.** Landings shall have a width not less than the width of the stairway or the door, whichever is the greater. Doors in the fully open position shall not reduce a required dimension by more than 800 mm. When a landing serves an occupant load of 50 or more, doors in any position shall not reduce the landing to less than one-half its required width. Landings shall have a length measured in the direction of travel of not less than 1.1 m.

**Exception:** Landing length in the direction of travel in Group R-3 as applicable in Section 8.1.1 and Group U and within individual units of Group R-2 as applicable in Section 8.1.1 need not exceed 900 mm.

**8.8.1.6 Thresholds.** Thresholds at doorways shall not exceed 19.1 mm in height for sliding doors serving dwelling units or 12.7 mm for other doors. Raised thresholds and floor level changes greater than 6.4 mm at doorways shall be beveled with a slope not greater than one unit vertical in two units horizontal (50 percent slope).

**Exception:** The threshold height shall be limited to 200 mm where the occupancy is Group R-2 or R-3 as applicable in Section 8.1.1, the door is an exterior door that is not a component of the required means of egress and the doorway is not on an accessible route.

**8.8.1.7 Door arrangement.** Space between two doors in series shall be 1.2 m minimum plus the width of a door swinging into the space. Doors in series shall swing either in the same direction or away from the space between doors.

**Exceptions:**

1. The minimum distance between horizontal sliding power-operated doors in a series shall be 1.2 m.
2. Storm and screen doors serving individual dwelling units in Groups R-2 and R-3 as applicable in Section 8.1.1 need not be spaced 1.2 m from the other door.
3. Doors within individual dwelling units in Groups R-2 and R-3 as applicable in Section 8.1.1 other than within Type A dwelling units.

**8.8.1.8 Door operations.** Except as specifically permitted by this section egress doors shall be readily openable from the egress side without the use of a key or special knowledge or effort.

**8.8.1.8.1 Hardware.** Door handles, pulls, latches, locks and other operating devices on doors required to be accessible by Chapter 9 of the SBC 201 shall not require tight grasping, tight pinching or twisting of the wrist to operate.

**8.8.2.8.2 Hardware height.** Door handles, pulls, latches, locks and other operating devices shall be installed 860 mm minimum and 1.2 m maximum above the finished floor. Locks used only for security purposes and not used for normal operation are permitted at any height.

**8.8.1.8.3 Locks and latches.** Locks and latches shall be permitted to prevent operation of doors where any of the following exists:

1. Places of detention or restraint.
2. In buildings in occupancy Group A having an occupant load of 300 or less, Groups B, F, M and S, and in Mosques, the main exterior door or doors are permitted to be equipped with key-operated locking devices from the egress side provided:
  - 2.1 The locking device is readily distinguishable as locked,
  - 2.2 A readily visible durable sign (*Arabic and English*) is posted on the egress side on or adjacent to the door stating: THIS DOOR TO REMAIN UNLOCKED WHEN BUILDING IS OCCUPIED. The sign shall be in letters 25 mm high on a contrasting background,
  - 2.3 The use of the key-operated locking device is revocable by the building code official for due cause.
3. Where egress doors are used in pairs, approved automatic flush bolts shall be permitted to be used, provided that the door leaf having the automatic flush bolts has no doorknob or surface-mounted hardware.
4. Doors from individual dwelling or sleeping units of Group R occupancies having an occupant load of 10 or less are permitted to be equipped with a night latch, dead bolt or security chain, provided such devices are openable from the inside without the use of a key or tool.

**8.8.1.8.4 Bolt locks.** Manually operated flush bolts or surface bolts are not permitted.

**Exceptions:**

1. On doors not required for egress in individual dwelling units or sleeping units.
2. Where a pair of doors serves a storage or equipment room, manually operated edge or surface-mounted bolts are permitted on the inactive leaf.

**8.8.1.8.5 Unlatching.** The unlatching of any leaf shall not require more than one operation.

**Exception:** More than one operation is permitted for unlatching doors in the following locations:

1. Places of detention or restraint.
2. Where manually operated bolt locks are permitted by Section 8.8.1.8.4.
3. Doors with automatic flush bolts as permitted by Section 8.8.1.8.3, Exception 3.
4. Doors from individual dwelling units and guestrooms of Group R occupancies as permitted by Section 8.8.1.8.3, Exception 4.

**8.8.1.8.6 Delayed egress locks.** Approved, listed, delayed egress locks shall be permitted to be installed on doors serving any occupancy except Group A, E and H occupancies in buildings that are equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or an approved automatic smoke or heat detection system installed in accordance with Section 7.7, provided that the doors unlock in accordance with Items 1 through 6 below. A building occupant shall not be required to pass through more than one door equipped with a delayed egress lock before entering an exit.

1. The doors unlock upon actuation of the automatic sprinkler system or automatic fire detection system.
2. The doors unlock upon loss of power controlling the lock or lock mechanism.
3. The door locks shall have the capability of being unlocked by a signal from the fire command center.
4. The initiation of an irreversible process which will release the latch in not more than 15 seconds when a force of not more than 67 N is applied for 1 second to the release device. Initiation of the irreversible process shall activate an audible signal in the vicinity of the door. Once the door lock has been

released by the application of force to the releasing device, relocking shall be by manual means only.

**Exception:** Where approved, a delay of not more than 30 seconds is permitted.

5. A sign (*Arabic and English*) shall be provided on the door located above and within 300 mm of the release device reading: PUSH UNTIL ALARM SOUNDS. DOOR CAN BE OPENED IN 15 [30] SECONDS.

6. Emergency lighting shall be provided at the door.

**8.8.1.8.7 Stairway doors.** Interior stairway means of egress doors shall be openable from both sides without the use of a key or special knowledge or effort.

**Exceptions:**

1. Stairway discharge doors shall be openable from the egress side and shall only be locked from the opposite side.
2. This section shall not apply to doors arranged in accordance with Section 2B.3.12.
3. In stairways serving not more than four stories, doors are permitted to be locked from the side opposite the egress side, provided they are openable from the egress side.

**8.8.1.9 Panic and fire exit hardware.** Where panic and fire exit hardware is installed, it shall comply with the following:

1. The actuating portion of the releasing device shall extend at least one-half of the door leaf width.
2. A maximum unlatching force of 67 N. Each door in a means of egress from an occupancy of Group A or E having an occupant load of 100 or more and any occupancy of Group H-1, H-2, H-3 or H-5 shall not be provided with a latch or lock unless it is panic hardware or fire exit hardware.

If balanced doors are used and panic hardware is required, the panic hardware shall be the push-pad type and the pad shall not extend more than one-half the width of the door measured from the latch side.

**8.8.2 Gates.** Gates serving the means of egress system shall comply with the requirements of this section. Gates used as a component in a means of egress shall conform to the applicable requirements for doors.

**Exception:** Horizontal sliding or swinging gates exceeding the 1.2 m maximum leaf width limitation are permitted in fences and walls surrounding a stadium.

**8.8.2.1 Stadiums.** Panic hardware is not required on gates surrounding stadiums where such gates are under constant immediate supervision while the public is present, and further provided that safe dispersal areas based on 0.28 m<sup>2</sup> per occupant are located between the fence and enclosed space. Such required safe dispersal areas shall not be located less than 15.3 m from the enclosed space. See Section 8.17 for means of egress from safe dispersal areas.

**8.8.3 Turnstiles.** Turnstiles or similar devices that restrict travel to one direction shall not be placed so as to obstruct any required means of egress.

**Exception:** Each turnstile or similar device shall be credited with no more than a 50-person capacity where all of the following provisions are met:

1. Each device shall turn free in the direction of egress travel when primary power is lost, and upon the manual release by an employee in the area.
2. Such devices are not given credit for more than 50 percent of the required egress capacity.
3. Each device is not more than 1.0 m high.

4. Each device has at least 400 mm clear width at and below a height of 1.0 m and at least 560 mm clear width at heights above 1.0 m.

Where located as part of an accessible route, turnstiles shall have at least 900 mm clear at and below a height of 860 mm, at least 800 mm clear width between 860 mm and 2.1 m and shall consist of a mechanism other than a revolving device.

**8.8.3.1 High turnstile.** Turnstiles more than 1.0 m high shall meet the requirements for revolving doors.

**8.8.3.2 Additional door.** Where serving an occupant load greater than 300, each turnstile that is not portable shall have a side-hinged swinging door which conforms to Section 8.8.1 within 15.3 m.

## SECTION 8.9 STAIRWAYS AND HANDRAILS

**8.9.1 Stairway width.** The width of stairways shall be determined as specified in Section 8.5.1, but such width shall not be less than 1.1 m. See Section 8.7.3 for accessible means of egress stairways.

**Exceptions:**

1. Stairways serving an occupant load of 50 or less shall have a width of not less than 900 mm.
2. Spiral stairways as provided for in Section 8.9.9.
3. Aisle stairs complying with Section 8.24.
4. Where a stairway lift is installed on stairways serving occupancies in Group R-3, or within dwelling units in occupancies in Group R-2, both as applicable in Section 8.1.1 a clear passage width not less than 500 mm shall be provided. If the seat and platform can be folded when not in use, the distance shall be measured from the folded position.

**8.9.2 Headroom.** Stairways shall have a minimum headroom clearance of 2.1 m measured vertically from a line connecting the edge of the nosings. Such headroom shall be continuous above the stairway to the point where the line intersects the landing below, one tread depth beyond the bottom riser. The minimum clearance shall be maintained the full width of the stairway and landing.  
**Exception:** Spiral stairways complying with Section 8.9.9 are permitted a 2.0 m headroom clearance.

**8.9.3 Stair treads and risers.** Stair riser heights shall be 180 mm maximum and 100 mm minimum. Stair tread depths shall be 280 mm minimum. The riser height shall be measured vertically between the leading edges of adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than 9.5 mm. The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than 9.5 mm. Winder treads shall have a minimum tread depth of 0.28 m measured at a right angle to the tread's leading edge at a point 300 mm from the side where the treads are narrower and a minimum tread depth of 0.25 m. The greatest winder tread depth at the 300 mm walk line within any flight of stairs shall not exceed the smallest by more than 9.5 mm.

**Exceptions:**

1. Circular stairways in accordance with Section 8.9.7.
2. Winders in accordance with Section 8.9.8.

3. Spiral stairways in accordance with Section 8.9.9.
4. Aisle stairs in assembly seating areas where the stair pitch or slope is set, for sightline reasons, by the slope of the adjacent seating area in accordance with Section 8.24.11.2.
5. In occupancies in Group R-3, as applicable in Section 8.1.1, within dwelling units in occupancies in Group R-2, as applicable in Section 8.1.1, and in occupancies in Group U, which are accessory to an occupancy in Group R-3, as applicable in Section 8.1.1, the maximum riser height shall be 200 mm and the minimum tread depth shall be 250 mm, the minimum winder tread depth at the walk line shall be 250 mm, and the minimum winder tread depth shall be 150 mm. A nosing not less than 19 mm but not more than 32 mm shall be provided on stairways with solid risers where the tread depth is less than 300 mm.
6. See the Chapter 9 for the replacement of existing stairways.

**8.9.3.1 Dimensional uniformity.** Stair treads and risers shall be of uniform size and shape. The tolerance between the largest and smallest riser or between the largest and smallest tread shall not exceed 9.5 mm in any flight of stairs.

**Exceptions:**

1. Non-uniform riser dimensions of aisle stairs complying with Section 8.24.11.2.
2. Consistently shaped winders, complying with Section 8.9.8, differing from rectangular treads in the same stairway flight.

Where the bottom or top riser adjoins a sloping public way, walkway or driveway having an established grade and serving as a landing, the bottom or top riser is permitted to be reduced along the slope to less than 100 mm in height with the variation in height of the bottom or top riser not to exceed one unit vertical in 12 units horizontal (8 percent slope) of stairway width. The nosings or leading edges of treads at such non-uniform height risers shall have a distinctive marking stripe, different from any other nosing marking provided on the stair flight. The distinctive marking stripe shall be visible in descent of the stair and shall have a slip-resistant surface. Marking stripes shall have a width of at least 25 mm but not more than 50 mm.

**8.9.3.2 Profile.** The radius of curvature at the leading edge of the tread shall be not greater than 12.7 mm. Beveling of nosings shall not exceed 12.7 mm. Risers shall be solid and vertical or sloped from the under-side of the leading edge of the tread above at an angle not more than 30 degrees (0.52 rad) from the vertical. The leading edge (nosings) of treads shall project not more than 30 mm beyond the tread below and all projections of the leading edges shall be of uniform size, including the leading edge of the floor at the top of a flight.

**Exceptions:**

1. Solid risers are not required for stairways that are not required to comply with Section 8.7.3, provided that the opening between treads does not permit the passage of a sphere with a diameter of 100 mm.
2. Solid risers are not required for occupancies in Group I-3.

**8.9.4 Stairway landings.** There shall be a floor or landing at the top and bottom of each stairway. The width of landings shall not be less than the width of stairways they serve. Every landing shall have a minimum dimension measured in the direction of travel equal to the width of the stairway. Such dimension need not exceed 1.2 m where the stairway has a straight run.

**Exceptions:**

1. Aisle stairs complying with Section 8.24.
2. Doors opening onto a landing shall not reduce the landing to less than one-half the required width. When fully open, the door shall not project more than 180 mm into a landing.

**8.9.5 Stairway construction.** All stairways shall be built of materials consistent with the types permitted for the type of construction of the building, except that wood handrails shall be permitted for all types of construction.

**8.9.5.1 Stairway walking surface.** The walking surface of treads and landings of a stairway shall not be sloped steeper than one unit vertical in 48 units horizontal (2 percent slope) in any direction. Stairway treads and landings shall have a solid surface. Finish floor surfaces shall be securely attached.

**Exception:** In Group F, H and S occupancies, other than areas of parking structures accessible to the public, openings in treads and landings shall not be prohibited provided a sphere with a diameter of 29 mm cannot pass through the opening.

**8.9.5.2 Outdoor conditions.** Outdoor stairways and outdoor approaches to stairways shall be designed so that water will not accumulate on walking surfaces. In other than occupancies in Group R-3, and occupancies in Group U that are accessory to an occupancy in Group R-3, treads, platforms and landings that are part of exterior stairways in climates subject to snow or ice shall be protected to prevent the accumulation of same.

**8.9.6 Vertical rise.** A flight of stairs shall not have a vertical rise greater than 3.7 m between floor levels or landings.

**Exception:** Aisle stairs complying with Section 8.24.

**8.9.7 Circular stairways.** Circular stairways shall have a minimum tread depth and a maximum riser height in accordance with Section 8.9.3 and the smaller radius shall not be less than twice the width of the stairway. The minimum tread depth measured 300 mm from the narrower end of the tread shall not be less than 280 mm. The minimum tread depth at the narrow end shall not be less than 250 mm.

**Exception:** For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, both as applicable in Section 8.1.1.

**8.9.8 Winders.** Winders are not permitted in means of egress stairways except within a dwelling unit.

**8.9.9 Spiral stairways.** Spiral stairways are permitted to be used as a component in the means of egress only within dwelling units or from a space not more than 23 m<sup>2</sup> in area and serving not more than five occupants, or from galleries, catwalks and gridirons in accordance with Section 8.14.6.

A spiral stairway shall have a 190 mm minimum clear tread depth at a point 300 mm from the narrow edge. The risers shall be sufficient to provide a headroom of 2.0 m minimum, but riser height shall not be more than 240 mm. The minimum stairway width shall be 660 mm.

**8.9.10 Alternating tread devices.** Alternating tread devices are limited to an element of a means of egress in buildings of Groups F, H and S from a mezzanine not more than 23 m<sup>2</sup> in area and which serves not more than five occupants; in buildings of



Group I-3 from a guard tower, observation station or control room not more than 23 m<sup>2</sup> in area and for access to unoccupied roofs.

**8.9.10.1 Handrails of alternating tread devices.** Handrails shall be provided on both sides of alternating tread devices and shall conform to Section 8.9.11.

**8.9.10.2 Treads of alternating tread devices.** Alternating tread devices shall have a minimum projected tread of 125 mm, a minimum tread depth of 215 mm, a minimum tread width of 180 mm and a maximum riser height of 240 mm. The initial tread of the device shall begin at the same elevation as the platform, landing or floor surface.

**Exception:** Alternating tread devices used as an element of a means of egress in buildings from a mezzanine area not more than 23 m<sup>2</sup> in area which serves not more than five occupants shall have a minimum projected tread of 215 mm with a minimum tread depth of 270 mm. The rise to the next alternating tread surface should not be more than 200 mm.

**8.9.11 Handrails.** Stairways shall have handrails on each side. Handrails shall be adequate in strength and attachment in accordance with Section 2.7 of SBC 301. Handrails for ramps, where required by Section 8.10.8, shall comply with this section.

**Exceptions:**

1. Aisle stairs complying with Section 8.24 provided with a center handrail need not have additional handrails.
2. Stairways within dwelling units, spiral stairways and aisle stairs serving seating only on one side are permitted to have a handrail on one side only.
3. Decks, patios and walkways that have a single change in elevation where the landing depth on each side of the change of elevation is greater than what is required for a landing do not require handrails.
4. In Group R-3 occupancies, a change in elevation consisting of a single riser at an entrance or egress door does not require handrails.
5. Changes in room elevations of only one riser within dwelling units and sleeping units in Group R-2 and R-3 occupancies do not require handrails.

**8.9.11.1 Height.** Handrail height, measured above stair tread nosings, or finish surface of ramp slope, shall be uniform, not less than 860 mm and not more than 960 mm.

**8.9.11.2 Intermediate handrails.** Intermediate handrails are required so that all portions of the stairway width required for egress capacity are within 750 mm of a handrail. On monumental stairs, handrails shall be located along the most direct path of egress travel.

**8.9.11.3 Handrail graspability.** Handrails with a circular cross section shall have an outside diameter of at least 32 mm and not greater than 50 mm or shall provide equivalent graspability. If the handrail is not circular, it shall have a perimeter dimension of at least 100 mm and not greater than 160 mm with a maximum cross-section dimension of 55 mm. Edges shall have a minimum radius of 0.25 mm.

**8.9.11.4 Continuity.** Handrail-gripping surfaces shall be continuous, without interruption by newel posts or other obstructions.

**Exceptions:**

1. Handrails within dwelling units are permitted to be interrupted by a newel post at a stair landing.
2. Within a dwelling unit, the use of a volute, turnout or starting easing is allowed on the lowest tread.
3. Handrail brackets or balusters attached to the bottom surface of the handrail

that do not project horizontally beyond the sides of the handrail within 38 mm of the bottom of the handrail shall not be considered to be obstructions and provided further that for each 13 mm of additional handrail perimeter dimension above 100 mm, the vertical clearance dimension of 38 mm shall be permitted to be reduced by 3 mm.

- 8.9.11.5 Handrail extensions.** Handrails shall return to a wall, guard or the walking surface or shall be continuous to the handrail of an adjacent stair flight. Where handrails are not continuous between flights, the handrails shall extend horizontally at least 300 mm beyond the top riser and continue to slope for the depth of one tread beyond the bottom riser.

**Exceptions:**

1. Handrails within a dwelling unit that is not required to be accessible need extend only from the top riser to the bottom riser.
2. Aisle handrails in Group A occupancies in accordance with Section 8.24.13.

- 8.9.11.6 Clearance.** Clear space between a handrail and a wall or other surface shall be a minimum of 38 mm. A handrail and a wall or other surface adjacent to the handrail shall be free of any sharp or abrasive elements.

- 8.9.11.7 Stairway projections.** Projections into the required width at each handrail shall not exceed 114 mm at or below the handrail height. Projections into the required width shall not be limited above the minimum headroom height required in Section 8.9.2.

- 8.9.12 Stairway to roof.** In buildings four or more stories in height above grade, one stairway shall extend to the roof surface, unless the roof has a slope steeper than four units vertical in 12 units horizontal (33 percent slope). In buildings without an occupied roof, access to the roof from the top story shall be permitted to be by an alternating tread device.

- 8.9.12.1 Roof access.** Where a stairway is provided to a roof, access to the roof shall be provided through a penthouse complying with Section 6.9.2 of SBC 201.

**Exception:** In buildings without an occupied roof, access to the roof shall be permitted to be a roof hatch or trap door not less than 1.5 m<sup>2</sup> in area and having a minimum dimension of 600 mm.

## SECTION 8.10 RAMPS

- 8.10.1 Scope.** The provisions of this section shall apply to ramps used as a component of a means of egress.

**Exceptions:**

1. Other than ramps that are part of the accessible routes providing access in accordance with Sections 9.8.2.2 through 9.8.2.4.1 of the SBC 201, ramped aisles within assembly rooms or spaces shall conform with the provisions in Section 8.24.11.
2. Curb ramps shall comply with ICC A117.1.
3. Vehicle ramps in parking garages for pedestrian exit access shall not be required to comply with Sections 8.10.3 through 8.10.9 when they are not an accessible route serving accessible parking spaces, other required accessible elements or part of an accessible means of egress.

- 8.10.2 Slope.** Ramps used as part of a means of egress shall have a running slope not steeper than one unit vertical in 12 units horizontal (8 percent slope). The slope of

other ramps shall not be steeper than one unit vertical in eight units horizontal (12.5 percent slope).

**Exception:** Aisle ramp slope in occupancies of Group A shall comply with Section 8.24.11.

- 8.10.3 **Cross slope.** The slope measured perpendicular to the direction of travel of a ramp shall not be steeper than one unit vertical in 48 units horizontal (2 percent slope).
- 8.10.4 **Vertical rise.** The rise for any ramp run shall be 750 mm maximum.
- 8.10.5 **Minimum dimensions.** The minimum dimensions of means of egress ramps shall comply with Sections 8.10.5.1 through 8.10.5.3.
  - 8.10.5.1 **Width.** The minimum width of a means of egress ramp shall not be less than that required for corridors by Section 8.16.2. The clear width of a ramp and the clear width between handrails, if provided, shall be 900 mm minimum.
  - 8.10.5.2 **Headroom.** The minimum headroom in all parts of the means of egress ramp shall not be less than 2.1 meters.
  - 8.10.5.3 **Restrictions.** Means of egress ramps shall not reduce in width in the direction of egress travel. Projections into the required ramp and landing width are prohibited. Doors opening onto a landing shall not reduce the clear width to less than 1.1 meters.
- 8.10.6 **Landings.** Ramps shall have landings at the bottom and top of each ramp, points of turning, entrance, exits and at doors. Landings shall comply with Sections 8.10.6.1 through 8.10.6.5.
  - 8.10.6.1 **Slope.** Landings shall have a slope not steeper than one unit vertical in 48 units horizontal (2 percent slope) in any direction. Changes in level are not permitted.
  - 8.10.6.2 **Width.** The landing shall be at least as wide as the widest ramp run adjoining the landing.
  - 8.10.6.3 **Length.** The landing length shall be 1.5 m minimum.  
**Exception:** Landings in non-accessible Group R-2 and R-3 individual dwelling units, as applicable in SBC 100 are permitted to be 900 mm minimum.
  - 8.10.6.4 **Change in direction.** Where changes in direction of travel occur at landings provided between ramp runs, the landing shall be 1.5 m by 1.5 m minimum.  
**Exception:** Landings in non-accessible Group R-2 and R-3 individual dwelling units, as applicable in SBC 100 are permitted to be 900 mm by 900 mm minimum.
  - 8.10.6.5 **Doorways.** Where doorways are located adjacent to a ramp landing, maneuvering clearances required by ICC A117.1 are permitted to overlap the required landing area.
- 8.10.7 **Ramp construction.** All ramps shall be built of materials consistent with the types permitted for the type of construction of the building; except that wood handrails shall be permitted for all types of construction. Ramps used as an exit shall conform to the applicable requirements of Sections 8.19.1 and 8.19.1.1 through 8.19.1.3 for vertical exit enclosures.
  - 8.10.7.1 **Ramp surface.** The surface of ramps shall be of slip-resistant materials that are securely attached.
  - 8.10.7.2 **Outdoor conditions.** Outdoor ramps and outdoor approaches to ramps shall be designed so that water will not accumulate on walking surfaces. In other than occupancies in Group R-3, and occupancies in Group U that are accessory to an occupancy in Group R-3, surfaces and landings which are part of exterior ramps in

climates subject to snow or ice shall be designed to minimize the accumulation of same.

- 8.10.8 Handrails.** Ramps with a rise greater than 150 mm shall have handrails on both sides complying with Section 8.9.11.
- 8.10.9 Edge protection.** Edge protection complying with Section 8.10.9.1 or 8.10.9.2 shall be provided on each side of ramp runs and at each side of ramp landings.
- Exceptions:**
1. Edge protection is not required on ramps not required to have handrails, provided they have flared sides that comply with the ICC A117.1 curb ramp provisions.
  2. Edge protection is not required on the sides of ramp landings serving an adjoining ramp run or stairway.
  3. Edge protection is not required on the sides of ramp landings having a vertical drop-off of not more than 13 mm within 250 mm horizontally of the required landing area.
- 8.10.9.1 Railings.** A rail shall be mounted below the handrail 430 mm to 480 mm above the ramp or landing surface.
- 8.10.9.2 Curb or barrier.** A curb or barrier shall be provided that prevents the passage of a 100 mm sphere, where any portion of the sphere is within 100 mm of the floor or ground surface.
- 8.10.10 Guards.** Guards shall be provided where required by Section 8.12 and shall be constructed in accordance with Section 8.12.

## SECTION 8.11 EXIT SIGNS

- 8.11.1 Where required.** Exits and exit access doors shall be marked by an approved exit bilingual sign (*Arabic and English*) readily visible from any direction of egress travel. Access to exits shall be marked by readily visible exit signs in cases where the exit or the path of egress travel is not immediately visible to the occupants. Exit sign placement shall be such that no point in an exit access corridor is more than 30.5 meters or the listed viewing distance for the sign, whichever is less, from the nearest visible exit sign.
- Exceptions:**
1. Exit bilingual signs (*Arabic and English*) are not required in rooms or areas which require only one exit or exit access.
  2. Main exterior exit doors or gates which obviously and clearly are identifiable as exits need not have exit signs where approved by the concerned building official.
  3. Exit signs are not required in occupancies in Group U and individual sleeping units or dwelling units in Group R-1, R-2 or R-3.
  4. Exit signs are not required in sleeping areas in occupancies in Group I-3.
  5. In occupancies in Groups A-4 and A-5, exit signs are not required on the seating side of vomitories or openings into seating areas where exit signs are provided in the concourse that are readily apparent from the vomitories. Egress lighting is provided to identify each vomitory or opening within the seating area in an emergency.

- 8.11.2 Illumination.** Exit signs shall be internally or externally illuminated.  
**Exception:** Tactile signs required by Section 8.11.3 need not be provided with illumination.
- 8.11.3 Tactile exit signs.** A tactile bilingual sign (*Arabic and English*) stating EXIT and complying with ICC A117.1 shall be provided adjacent to each door to an egress stairway, an exit passageway and the exit discharge.
- 8.11.4 Internally illuminated exit signs.** Internally illuminated exit signs shall be listed and labeled and shall be installed in accordance with the manufacturer's instructions, Section 5D.4 and SBC 401 exit signs shall be illuminated at all times.
- 8.11.5 Externally illuminated exit signs.** Externally illuminated exit signs shall comply with Sections 8.11.5.1 through 8.11.5.3.
- 8.11.5.1 Graphics.** Every exit sign and directional exit sign shall have plainly legible letters not less than 150 mm high with the principal strokes of the letters not less than 19 mm wide. The word "EXIT" shall be bilingual (*Arabic and English*) and have letters having a width not less than 50 mm wide except the letter "I," and the minimum spacing between letters shall not be less than 9.5 mm. Signs larger than the minimum established in this section shall have letter widths, strokes and spacing in proportion to their height. The word "EXIT" shall be in high contrast with the background and shall be clearly discernible when the exit sign illumination means is or is not energized. If an arrow is provided as part of the exit sign, the construction shall be such that the arrow direction cannot be readily changed.
- 8.11.5.2 Exit sign illumination.** The face of an exit sign illuminated from an external source shall have an intensity of not less than 54 lux.
- 8.11.5.3 Power source.** Exit signs shall be illuminated at all times. To ensure continued illumination for a duration of not less than 90 minutes in case of primary power loss, the sign illumination means shall be connected to an emergency power system provided from storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with SBC 401.  
**Exception:** Approved exit sign illumination means that provide continuous illumination independent of external power sources for a duration of not less than 90 minutes, in case of primary power loss, are not required to be connected to an emergency electrical system.

## SECTION 8.12

### GUARDS

- 8.12.1 Where required.** Guards shall be located along open-sided walking surfaces, mezzanines, industrial equipment platforms, stairways, ramps and landings which are located more than 750 mm above the floor or grade below. Guards shall be adequate in strength and attachment in accordance with SBC 301. Guards shall also be located along glazed sides of stairways, ramps and landings that are located more than 750 mm above the floor or grade below where the glazing provided does not meet the strength and attachment requirements in SBC 301.  
**Exception:** Guards are not required for the following locations:
1. On the loading side of loading docks or piers.
  2. On the audience side of stages and raised platforms, including steps leading

up to the stage and raised platforms.

3. On raised stage and platform floor areas such as runways, ramps and side stages used for entertainment or presentations.
4. At vertical openings in the performance area of stages and platforms.
5. At elevated walking surfaces appurtenant to stages and platforms for access to and utilization of special lighting or equipment.
6. Along vehicle service pits not accessible to the public.
7. In assembly seating where guards in accordance with Section 8.24.14 are permitted and provided.

**8.12.2 Height.** Guards shall form a protective barrier not less than 1.1 meters high, measured vertically above the leading edge of the tread, adjacent walking surface or adjacent seatboard.

**Exceptions:**

1. For occupancies in Group R-3, and within individual dwelling units in occupancies in Group R-2, both as applicable in SBC 100 guards whose top rail also serves as a handrail shall have a height not less than 860 mm and not more than 960 mm measured vertically from the leading edge of the stair tread nosing.
2. The height in assembly seating areas shall be in accordance with Section 8.24.14.

**8.12.3 Opening limitations.** Open guards shall have balusters or ornamental patterns such that a 100 mm sphere cannot pass through any opening up to a height of 860 mm. From a height of 860 mm to 1070 mm above the adjacent walking surfaces, a sphere 200 mm in diameter shall not pass.

**Exceptions:**

1. The triangular openings formed by the riser, tread and bottom rail at the open side of a stairway shall be of a maximum size such that a sphere of 150 mm in diameter cannot pass through the opening.
2. At elevated walking surfaces for access to and use of electrical, mechanical or plumbing systems or equipment, guards shall have balusters or be of solid materials such that a sphere with a diameter of 530 mm cannot pass through any opening.
3. In areas which are not open to the public within occupancies in Group I-3, F, H or S, balusters, horizontal intermediate rails or other construction shall not permit a sphere with a diameter of 530 mm to pass through any opening.
4. In assembly seating areas, guards at the end of aisles where they terminate at a fascia of boxes, balconies and galleries shall have balusters or ornamental patterns such that a 100 mm-diameter sphere cannot pass through any opening up to a height of 660 mm. From a height of 660 mm to 1070 mm above the adjacent walking surfaces, a sphere 200 mm in diameter shall not pass.

**8.12.4 Screen porches.** Porches and decks which are enclosed with insect screening shall be provided with guards where the walking surface is located more than 750 mm above the floor or grade below.

**8.12.5 Mechanical equipment.** Guards shall be provided where appliances, equipment, fans or other components that require service are located within 3 meters of a roof edge or open side of a walking surface and such edge or open side is located more



than 750 mm above the floor, roof or grade below. The guard shall be constructed so as to prevent the passage of a 530 mm-diameter sphere.

### SECTION 8.13 EXIT ACCESS

**8.13.1 General.** The exit access arrangement shall comply with Sections 8.13 through 8.16 and the applicable provisions of Sections 8.3 through 8.12.

**8.13.2 Egress through intervening spaces.** Egress from a room or space shall not pass through adjoining or intervening rooms or areas, except where such adjoining rooms or areas are accessory to the area served; are not a high-hazard occupancy and provide a discernible path of egress travel to an exit. Egress shall not pass through kitchens, storage rooms, closets or spaces used for similar purposes. An exit access shall not pass through a room that can be locked to prevent egress. Means of egress from dwelling units or sleeping areas shall not lead through other sleeping areas, toilet rooms or bathrooms.

**Exceptions:**

1. Means of egress are not prohibited through a kitchen area serving adjoining rooms constituting part of the same dwelling unit or sleeping unit.
2. Means of egress are not prohibited through adjoining or intervening rooms or spaces in a Group H occupancy when the adjoining or intervening rooms or spaces are the same or a lesser hazard occupancy group.

**8.13.2.1 Multiple tenants.** Where more than one tenant occupies any one floor of a building or structure, each tenant space, dwelling unit and sleeping unit shall be provided with access to the required exits without passing through adjacent tenant spaces, dwelling units and sleeping units.

**8.13.2.2 Group I-2.** Habitable rooms or suites in Group I-2 occupancies shall have an exit access door leading directly to an exit access corridor.

**Exceptions:**

1. Rooms with exit doors opening directly to the outside at ground level.
2. Patient sleeping rooms are permitted to have one intervening room if the intervening room is not used as an exit access for more than eight patient beds.
3. Special nursing suites are permitted to have one intervening room where the arrangement allows for direct and constant visual supervision by nursing personnel.
4. For rooms other than patient sleeping rooms, suites of rooms are permitted to have one intervening room if the travel distance within the suite to the exit access door is not greater than 30.5 m and are permitted to have two intervening rooms where the travel distance within the suite to the exit access door is not greater than 15.3 m.

Suites of sleeping rooms shall not exceed 465 m<sup>2</sup>. Suites of rooms, other than patient sleeping rooms, shall not exceed 929 m<sup>2</sup>. Any patient sleeping room, or any suite that includes patient sleeping rooms, of more than 93 m<sup>2</sup> shall have at least two exit access doors remotely located from each other. Any room or suite of rooms, other than patient sleeping rooms, of more than 232 m<sup>2</sup> shall have at least two access doors remotely located from each other. The travel distance between any point in a Group I-2 occupancy and an exit access door in the room shall not exceed 15.3 m. The travel distance between any point in a suite of sleeping rooms and an exit access door of that suite shall not exceed 30.5 m.

**8.13.3 Common path of egress travel.** In occupancies other than Groups H-1, H-2 and H-3, the common path of egress travel shall not exceed 23 m. In occupancies in Groups H-1, H-2, and H-3, the common path of egress travel shall not exceed 7.6 m.

**Exceptions:**

1. The length of a common path of egress travel in an occupancy in Groups B, F and S shall not be more than 30.5 m, provided that the building is equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
2. Where a tenant space in an occupancy in Groups B, S and U has an occupant load of not more than 30, the length of a common path of egress travel shall not be more than 30.5 m.
3. The length of a common path of egress travel in occupancies in Group I-3 shall not be more than 30.5 m.

**8.13.4 Aisles.** Aisles serving as a portion of the exit access in the means of egress system shall comply with the requirements of this section. Aisles shall be provided from all occupied portions of the exit access which contain seats, tables, furnishings, displays and similar fixtures or equipment. Aisles serving assembly areas, other than seating at tables, shall comply with Section 8.24. Aisles serving reviewing stands, grandstands and bleachers shall also comply with Section 8.24.

The required width of aisles shall be unobstructed.

**Exception:** Doors, when fully opened, and handrails shall not reduce the required width by more than 180 mm. Doors in any position shall not reduce the required width by more than one-half. Other nonstructural projections such as trim and similar decorative features are permitted to project into the required width 38 mm from each side.

**8.13.4.1 Groups B and M.** In Group B and M occupancies, the minimum clear aisle width shall be determined by Section 8.5.1 for the occupant load served, but shall not be less than 900 mm.

**Exception:** Nonpublic aisles serving less than 50 people, and not required to be accessible by Chapter 9 need not exceed 710 mm in width.

**8.13.4.2 Seating at tables.** Where seating is located at a table or counter and is adjacent to an aisle or aisle access way, the measurement of required clear width of the aisle or aisle accessway shall be made to a line 480 mm away from and parallel to the edge of the table or counter. The 480 mm distance shall be measured perpendicular to the side of the table or counter. In the case of other side boundaries for aisle or aisle access ways, the clear width shall be measured to walls, edges of seating and tread edges, except that handrail projections are permitted.

**Exception:** Where tables or counters are served by fixed seats, the width of the aisle accessway shall be measured from the back of the seat.

**8.13.4.2.1 Aisle accessway for tables and seating.** Aisle accessways serving arrangements of seating at tables or counters shall have sufficient clear width to conform to the capacity requirements of Section 8.5.1 but shall not have less than the appropriate minimum clear width specified in Section 8.13.4.1.

**8.13.4.2.2 Table and seating accessway width.** Aisle accessways shall provide a minimum of 300 mm of width plus 12.7 mm of width for each additional 0.3 m, or fraction thereof, beyond 3.7 m of aisle accessway length measured from the center of the seat farthest from an aisle.

**Exception:** Portions of an aisle accessway having a length not exceeding 1.8 m and used by a total of not more than four persons.



- 8.13.4.2.3 Table and seating aisle accessway length.** The length of travel along the aisle accessway shall not exceed 9.1 m from any seat to the point where a person has a choice of two or more paths of egress travel to separate exits.
- 8.13.5 Egress balconies.** Balconies used for egress purposes shall conform to the same requirements as corridors for width, headroom, dead ends and projections. Exterior balconies shall be designed to minimize accumulation of snow or ice that impedes the means of egress.
- Exception:** Exterior balconies and concourses in outdoor stadiums shall be exempt from the design requirement to protect against the accumulation of snow or ice.
- 8.13.5.1 Wall separation.** Exterior egress balconies shall be separated from the interior of the building by walls and opening protectives as required for corridors.
- Exception:** Separation is not required where the exterior egress balcony is served by at least two stairs and a dead-end travel condition does not require travel past an unprotected opening to reach a stair.
- 8.13.5.2 Openness.** The long side of an egress balcony shall be at least 50 percent open, and the open area above the guards shall be so distributed as to minimize the accumulation of smoke or toxic gases.

## SECTION 8.14

### EXIT AND EXIT ACCESS DOORWAYS

- 8.14.1 Exit or exit access doorways required.** Two exits or exit access doorways from any space shall be provided where one of the following conditions exists:
1. The occupant load of the space exceeds the values in Table 8.14.1.
  2. The common path of egress travel exceeds the limitations of Section 8.13.3.
  3. Where required by Sections 8.14.3, 8.14.4 and 8.14.5.
- Exception:** Group I-2 occupancies shall comply with Section 8.13.2.2.

**TABLE 8.14.1**  
**SPACES WITH ONE MEANS OF EGRESS**

OCCUPANCY	MAXIMUM OCCUPANT LOAD
A, B, E, F, M, U	50
H-1, H-2, H-3	3
H-4, H-5, I-1, I-3, I-4, R	10
S	30

- 8.14.1.1 Three or more exits.** Access to three or more exits shall be provided from a floor area where required by Section 8.18.1.
- 8.14.2 Exit or exit access doorway arrangement.** Required exits shall be located in a manner that makes their availability obvious. Exits shall be unobstructed at all times. Exit and exit access doorways shall be arranged in accordance with Sections 8.14.2.1 and 8.14.2.2.
- 8.14.2.1 Two exits or exit access doorways.** Where two exits or exit access doorways are required from any portion of the exit access, the exit doors or exit access doorways shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served measured in a straight line between exit doors or exit access doorways. Interlocking or scissor stairs shall be counted as one exit stairway.

**Exceptions:**

1. Where exit enclosures are provided as a portion of the required exit and are interconnected by a 1-hour fire-resistance-rated corridor conforming to the requirements of Section 8.16, the required exit separation shall be measured along the shortest direct line of travel within the corridor.
2. Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, the separation distance of the exit doors or exit access doorways shall not be less than one-third of the length of the maximum overall diagonal dimension of the area served.

**8.14.2.2 Three or more exits or exit access doorways.** Where access to three or more exits is required, at least two exit doors or exit access doorways shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the area served measured in a straight line between such exit doors or exit access doorways. Additional exits or exit access doorways shall be arranged a reasonable distance apart so that if one becomes blocked, the others will be available.

**Exception:** Where a building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, the separation distance of at least two of the exit doors or exit access doorways shall not be less than one-third of the length of the maximum overall diagonal dimension of the area served.

**8.14.3 Boiler, incinerator and furnace rooms.** Two exit access doorways are required in boiler, incinerator and furnace rooms where the area is over 46 m<sup>2</sup> and any fuel-fired equipment exceeds 422,000 KJ input capacity. Where two exit access doorways are required, one is permitted to be a fixed ladder or an alternating tread device. Exit access doorways shall be separated by a horizontal distance equal to one-half the maximum horizontal dimension of the room.

**8.14.4 Refrigeration machinery rooms.** Machinery rooms larger than 93 m<sup>2</sup> shall have not less than two exits or exit access doors. Where two exit access doorways are required, one such doorway is permitted to be served by a fixed ladder or an alternating tread device. Exit access doorways shall be separated by a horizontal distance equal to one-half the maximum horizontal dimension of room.

All portions of machinery rooms shall be within 46 m of an exit or exit access doorway. An increase in travel distance is permitted in accordance with Section 8.15.1.

Doors shall swing in the direction of egress travel, regardless of the occupant load served. Doors shall be tight fitting and self-closing.

**8.14.5 Refrigerated rooms or spaces.** Rooms or spaces having a floor area of 93 m<sup>2</sup> or more, containing a refrigerant evaporator and maintained at a temperature below 20°C, shall have access to not less than two exits or exit access doors.

Travel distance shall be determined as specified in Section 8.15.1, but all portions of a refrigerated room or space shall be within 46 m of an exit or exit access door where such rooms are not protected by an approved automatic sprinkler system. Egress is allowed through adjoining refrigerated rooms or spaces.

**Exception:** Where using refrigerants in quantities limited to the amounts based on the volume set forth in the SBC 501.

**8.14.6 Stage means of egress.** Where two means of egress are required, based on the stage size or occupant load, one means of egress shall be provided on each side of the stage.

**8.14.6.1 Gallery, gridiron and catwalk means of egress.** The means of egress from lighting and access catwalks, galleries and gridirons shall meet the requirements for occupancies in Group F-2.

**Exceptions:**

1. A minimum width of 560 mm is permitted for lighting and access catwalks.
2. Spiral stairs are permitted in the means of egress.
3. Stairways required by this subsection need not be enclosed.
4. Stairways with a minimum width of 560 mm, ladders, or spiral stairs are permitted in the means of egress.
5. A second means of egress is not required from these areas where a means of escape to a floor or to a roof is provided. Ladders, alternating tread devices or spiral stairs are permitted in the means of escape.
6. Ladders are permitted in the means of egress.

## **SECTION 8.15**

### **EXIT ACCESS TRAVEL DISTANCE**

**8.15.1 Travel distance limitations.** Exits shall be so located on each story such that the maximum length of exit access travel, measured from the most remote point within a story to the entrance to an exit along the natural and unobstructed path of egress travel, shall not exceed the distances given in Table 8.15.1.

Where the path of exit access includes unenclosed stairways or ramps within the exit access or includes unenclosed exit ramps or stairways as permitted in Section 8.19.1, the distance of travel on such means of egress components shall also be included in the travel distance measurement. The measurement along stairways shall be made on a plane parallel and tangent to the stair tread no sings in the center of the stairway.

**Exceptions:**

1. Travel distance in open parking garages is permitted to be measured to the closest riser of open stairs.
2. In outdoor facilities with open exit access components and open exterior stairs or ramps, travel distance is permitted to be measured to the closest riser of a stair or the closest slope of the ramp.
3. Where an exit stair is permitted to be unenclosed in accordance with Exception 8 or 9 of Section 8.19.1, the travel distance shall be measured from the most remote point within a building to an exit discharge.

**TABLE 8.15.1**  
**EXIT ACCESS TRAVEL DISTANCE<sup>a</sup>**

<b>OCCUPANCY</b>	<b>WITHOUT SPRINKLER SYSTEM (meters)</b>	<b>WITH SPRINKLER SYSTEM (meters)</b>
A, E, F-1, I-1, M, R, S-1	61	76.2 <sup>b</sup>
B	61	91.5 <sup>c</sup>
F-2, S-2, U	91.5	122 <sup>b</sup>
H-1	Not Permitted	23 <sup>c</sup>
H-2	Not Permitted	30.5 <sup>c</sup>
H-3	Not Permitted	45.7 <sup>c</sup>
H-4	Not Permitted	53.3 <sup>c</sup>
H-5	Not Permitted	61 <sup>c</sup>
I-2, I-3, I-4	45.7	61 <sup>c</sup>

- a. See the following sections for modifications to exit access travel distance requirements:  
 Section 2A.2: For the distance limitation in malls.  
 Section 2B.4: For the distance limitation through an atrium space.  
 Section 8.15.2: For increased limitation in Groups F-1 and S-1.  
 Section 8.24.7: For increased limitation in assembly seating.  
 Section 8.24.7: For increased limitation for assembly open-air seating.  
 Section 8.18.2: For buildings with one exit.  
 Section 4.4 of the SBC 201: For the limitation in temporary structures.
- b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2. See Section 7.3 for occupancies where sprinkler systems according to Section 7.3.3.1.2 are permitted.
- c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

**8.15.2 Roof vent increase.** In buildings which are one story in height, equipped with automatic heat and smoke roof vents complying with Section 7.10 and equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, the maximum exit access travel distance shall be 122 m for occupancies in Group F-1 or S.

**8.15.3 Exterior egress balcony increase.** Travel distances specified in Section 8.15.1 shall be increased up to an additional 30.5 m provided the last portion of the exit access leading to the exit occurs on an exterior egress balcony constructed in accordance with Section 8.13.5. The length of such balcony shall not be less than the amount of the increase taken.

## SECTION 8.16 CORRIDORS

**8.16.1 Construction.** Corridors shall be fire-resistance rated in accordance with Table 8.16.1. The corridor walls required to be fire-resistance rated shall comply with Section 4B.8 for fire partitions.

**Exceptions:**

1. A fire-resistance rating is not required for corridors in an occupancy in Group E where each room that is used for instruction has at least one door directly to the exterior and rooms for assembly purposes have at least one-half of the required means of egress doors opening directly to the exterior. Exterior doors specified in this exception are required to be at ground level.
2. A fire-resistance rating is not required for corridors contained within a dwelling or sleeping unit in an occupancy in Group R.
3. A fire-resistance rating is not required for corridors in open parking garages.

4. A fire-resistance rating is not required for corridors in an occupancy in Group B which is a space requiring only a single means of egress complying with Section 8.14.1.

**TABLE 8.16.1**  
**CORRIDOR FIRE-RESISTANCE RATING**

OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system <sup>c</sup>
H-1, H-2, H-3	All	Not Permitted	1
H-4, H-5	Greater than 30	Not Permitted	1
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	1	0.5
I-2 <sup>a</sup> , I-4	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1 <sup>b</sup>

- a. For requirements for occupancies in Group I-2, see Section 2B.7.3.  
b. For a reduction in the fire-resistance rating for occupancies in Group I-3, see Section 2B.8.7.  
c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 where allowed.

- 8.16.2 Corridor width.** The minimum corridor width shall be as determined in Section 8.5.1, but not less than 1.1 m.

**Exceptions:**

1. Six hundred and ten millimeters – For access to and utilization of electrical, mechanical or plumbing systems or equipment.
2. Nine hundred and fourteen millimeters – With a required occupant capacity of 50 or less.
3. Nine hundred and fourteen millimeters – Within a dwelling unit.
4. One thousand eight hundred and twenty nine millimeters – In Group E with a corridor having a required capacity of 100 or more.
5. One thousand eight hundred and twenty nine millimeters – In corridors serving surgical Group I, health care centers for ambulatory patients receiving outpatient medical care, which causes the patient to be not capable of self-preservation.
6. Two thousands four hundred and thirty eight millimeters – In Group I-2 in areas where required for bed movement.

- 8.16.3 Dead ends.** Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 6.1 m in length.

**Exceptions:**

1. In occupancies in Group I-3 of Occupancy Condition 2, 3 or 4 (see Section 1.2, definition of Occupancy Group I-3), the dead end in a corridor shall not exceed 15.3 m.
2. In occupancies in Groups B and F where the building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1, the length of dead-end corridors shall not exceed 15.3 m.
3. A dead-end corridor shall not be limited in length where the length of the dead-end corridor is less than 2.5 times the least width of the dead-end corridor.

- 8.16.4 Air movement in corridors.** Exit access corridors shall not serve as supply, return, exhaust, relief or ventilation air ducts or plenums.

**Exceptions:**

1. Use of a corridor as a source of makeup air for exhaust systems in rooms that open directly onto such corridors, including toilet rooms, bathrooms, dressing rooms, smoking lounges and janitor closets, shall be permitted provided that each such corridor is directly supplied with outdoor air at a rate greater than the rate of makeup air taken from the corridor.
2. Where located within a dwelling unit, the use of corridors for conveying return air shall not be prohibited.
3. Where located within tenant spaces of 93 m<sup>2</sup> or less in area, utilization of corridors for conveying return air is permitted.

**8.16.4.1 Corridor ceiling.** Use of the space between the corridor ceiling and the floor or roof structure above as a return air plenum is permitted for one or more of the following conditions:

1. The corridor is not required to be of fire-resistance-rated construction;
2. The corridor is separated from the plenum by fire-resistance-rated construction;
3. The air-handling system serving the corridor is shutdown upon activation of the air-handling unit smoke detectors required by the SBC 501;
4. The air-handling system serving the corridor is shut down upon detection of sprinkler waterflow where the building is equipped throughout with an automatic sprinkler system; or
5. The space between the corridor ceiling and the floor or roof structure above the corridor is used as a component of an approved engineered smoke control system.

**8.16.5 Corridor continuity.** Fire-resistance-rated corridors shall be continuous from the point of entry to an exit, and shall not be interrupted by intervening rooms.

**Exception:** Foyers, lobbies or reception rooms constructed as required for corridors shall not be construed as intervening rooms.

## SECTION 8.17

### EXITS

**8.17.1 General.** Exits shall comply with Sections 8.17 through 8.22 and the applicable requirements of Sections 8.3 through 8.12. An exit shall not be used for any purpose that interferes with its function as a means of egress. Once a given level of exit protection is achieved, such level of protection shall not be reduced until arrival at the exit discharge.

**8.17.2 Exterior exit doors.** Buildings or structures used for human occupancy shall have at least one exterior door that meets the requirements of Section 8.8.1.1.

**8.17.2.1 Detailed requirements.** Exterior exit doors shall comply with the applicable requirements of Section 8.8.1.

**8.17.2.2 Arrangement.** Exterior exit doors shall lead directly to the exit discharge or the public way.

## SECTION 8.18

### NUMBER OF EXITS AND CONTINUITY

**8.18.1 Minimum number of exits.** All rooms and spaces within each story shall be provided with and have access to the minimum number of approved independent

exits as required by Table 8.18.1 based on the occupant load, except as modified in Section 8.14.1 or 8.18.2. For the purposes of this chapter, occupied roofs shall be provided with exits as required for stories. The required number of exits from any story, basement or individual space shall be maintained until arrival at grade or the public way.

**TABLE 8.18.1**  
**MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD**

OCCUPANT LOAD	MINIMUM NUMBER OF EXITS
1-500	2
501-1,000	3
More than 1,000	4

**8.18.1.1 Open parking structures.** Parking structures shall not have less than two exits from each parking tier, except that only one exit is required where vehicles are mechanically parked. Unenclosed vehicle ramps shall not be considered as required exits unless pedestrian facilities are provided.

**8.18.1.2 Helistops.** The means of egress from helistops shall comply with the provisions of this chapter, provided that landing areas located on buildings or structures shall have two or more exits. For landing platforms or roof areas less than 18.3 m long, or less than 186 m<sup>2</sup> in area, the second means of egress is permitted to be a fire escape or ladder leading to the floor below.

**8.18.2 Buildings with one exit.** Only one exit shall be required in buildings as described below:

1. Buildings described in Table 8.18.2, provided that the building has not more than one level below the first story above grade plane.
2. Buildings of Group R-3 occupancy.
3. Single-level buildings with the occupied space at the level of exit discharge provided that the story or space complies with Section 8.14.1 as a space with one means of egress.

**TABLE 8.18.2**  
**BUILDINGS WITH ONE EXIT**

OCCUPANCY	MAXIMUM HEIGHT OF BUILDING ABOVE GRADE PLANE	MAXIMUM OCCUPANTS (OR DWELLING UNITS) PER FLOOR AND TRAVEL DISTANCE
A, B <sup>d</sup> , E, F, M, U	1 Story	50 occupants and 23 meters travel distance
H-2, H-3	1 Story	3 occupants and 7.6 meters travel distance
H-4, H-5, I, R	1 Story	10 occupants and 23 meters travel distance
S <sup>a</sup>	1 Story	30 occupants and 30.5 meters travel distance
B <sup>b</sup> , F, M, S <sup>a</sup>	2 Stories	30 occupants and 23 meters travel distance
R-2	2 Stories <sup>c</sup>	4 dwelling units and 15.3 meters travel distance

- a. For the required number of exits for open parking structures, see Section 8.18.1.1.
- b. For the required number of exits for air traffic control towers, see Section 2B.12.1.
- c. Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 8.25 shall have a maximum height of three stories above grade.
- d. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 with an occupancy in Group B shall have a maximum travel distance of 30.5 meters.

- 8.18.3 Exit continuity.** Exits shall be continuous from the point of entry into the exit to the exit discharge.
- 8.18.4 Exit door arrangement.** Exit door arrangement shall meet the requirements of Sections 8.14.2 through 8.14.2.2.

## SECTION 8.19 VERTICAL EXIT ENCLOSURES

- 8.19.1 Enclosures required.** Interior exit stairways and interior exit ramps shall be enclosed with fire barriers. Exit enclosures shall have a fire-resistance rating of not less than 2 hours where connecting four stories or more and not less than 1 hour where connecting less than four stories. The number of stories connected by the shaft enclosure shall include any basements but not any mezzanines. An exit enclosure shall not be used for any purpose other than means of egress. Enclosures shall be constructed as fire barriers in accordance with Section 4B.6.

**Exceptions:**

1. In other than Group H and I occupancies, a stairway serving an occupant load of less than 10 not more than one story above the level of exit discharge is not required to be enclosed.
2. Exits in buildings of Group A-5 where all portions of the means of egress are essentially open to the outside need not be enclosed.
3. Stairways serving and contained within a single residential dwelling unit or sleeping unit in occupancies in Group R-2 or R-3 and sleeping units in occupancies in Group R-1 are not required to be enclosed.
4. Stairways that are not a required means of egress element are not required to be enclosed where such stairways comply with Section 4B.7.2.
5. Stairways in open parking structures which serve only the parking structure are not required to be enclosed.
6. Stairways in occupancies in Group I-3 as provided for in Section 2B.8.3.6 are not required to be enclosed.
7. Means of egress stairways as required by Section 2B.10.5.4 are not required to be enclosed.
8. In other than occupancy Groups H and I, a maximum of 50 percent of egress stairways serving one adjacent floor are not required to be enclosed, provided at least two means of egress are provided from both floors served by the unenclosed stairways. Any two such interconnected floors shall not be open to other floors.
9. In other than occupancy Groups H and I, interior egress stairways serving only the first and second stories of a building equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 are not required to be enclosed, provided at least two means of egress are provided from both floors served by the unenclosed stairways. Such interconnected stories shall not be open to other stories.

- 8.19.1.1 Openings and penetrations.** Exit enclosure opening protectives shall be in accordance with the requirements of Section 4B.15.

Except as permitted in Section 2B.2.4.6, openings in exit enclosures other than unexposed exterior openings shall be limited to those necessary for exit access to the enclosure from normally occupied spaces and for egress from the enclosure.

While interior exit enclosures are extended to the exterior of a building by an exit passageway, the door assembly from the exit enclosure to the exit passageway



shall be protected by a fire door conforming to the requirements in Section 4B.15.3. Fire door assemblies in exit enclosures shall comply with Section 4B.15.3.4.

**8.19.1.2 Penetrations.** Penetrations into and openings through an exit enclosure are prohibited except for required exit doors, equipment and ductwork necessary for independent pressurization, sprinkler piping, standpipes, electrical raceway for fire department communication and electrical raceway serving the exit enclosure and terminating at a steel box not exceeding 0.010 m<sup>2</sup>. Such penetrations shall be protected in accordance with Section 4B.12. There shall be no penetrations or communication openings, whether protected or not, between adjacent exit enclosures.

**8.19.1.3 Ventilation.** Equipment and ductwork for exit enclosure ventilation shall comply with one of the following items:

1. Such equipment and ductwork shall be located exterior to the building and shall be directly connected to the exit enclosure by ductwork enclosed in construction as required for shafts.
2. Where such equipment and ductwork is located within the exit enclosure, the intake air shall be taken directly from the outdoors and the exhaust air shall be discharged directly to the outdoors, or such air shall be conveyed through ducts enclosed in construction as required for shafts.
3. Where located within the building, such equipment and ductwork shall be separated from the remainder of the building, including other mechanical equipment, with construction as required for shafts.

In each case, openings into the fire-resistance-rated construction shall be limited to those needed for maintenance and operation and shall be protected by self-closing fire-resistance-rated devices in accordance with Section 4B of Chapter 4 for enclosure wall opening protectives. Exit enclosure ventilation systems shall be independent of other building ventilation systems.

**8.19.1.4 Vertical enclosure exterior walls.** Exterior walls of a vertical exit enclosure shall comply with the requirements of Section 4B.4 for exterior walls. Where nonrated walls or unprotected openings enclose the exterior of the stairway and the walls or openings are exposed by other parts of the building at an angle of less than 180 degrees (3.14 rad), the building exterior walls within 3.1 m horizontally of a nonrated wall or unprotected opening shall be constructed as required for a minimum 1-hour fire-resistance rating with 3/4-hour opening protectives. This construction shall extend vertically from the ground to a point 3.1 m above the topmost landing of the stairway or to the roof line, whichever is lower.

**8.19.1.5 Enclosures under stairways.** The walls and soffits within enclosed usable spaces under enclosed and unenclosed stairways shall be protected by 1-hour fire-resistance-rated construction, or the fire-resistance rating of the stairway enclosure, whichever is greater. Access to the enclosed usable space shall not be directly from within the stair enclosure.

**Exception:** Spaces under stairways serving and contained within a single residential dwelling unit in Group R-2 or R-3 as applicable in Section 8.1.1. There shall be no enclosed usable space under exterior exit stairways unless the space is completely enclosed in 1-hour fire-resistance-rated construction. The open space under exterior stairways shall not be used for any purpose.

**8.19.1.6 Discharge identification.** A stairway in an exit enclosure shall not continue below the level of exit discharge unless an approved barrier is provided at the level of exit discharge to prevent persons from unintentionally continuing into levels below. Directional exit signs shall be provided as specified in Section 8.11.

- 8.19.1.7 Stairway floor number signs.** A sign shall be provided at each floor landing in interior vertical exit enclosures connecting more than three stories designating the floor level, the terminus of the top and bottom of the stair enclosure and the identification of the stair. The signage shall also state the story of, and the direction to the exit discharge and the availability of roof access from the stairway for the Civil Defense. The sign shall be located 1.5 m above the floor landing in a position which is readily visible when the doors are in the open and closed positions.
- 8.19.1.8 Smoke-proof enclosures.** In buildings required to comply with Section 5B.3 or 5B.5, each of the exits of a building that serves stories where the floor surface is located more than 23 m above the lowest level of Civil Defense vehicle access or more than 9.1 m below the level of exit discharge serving such floor levels shall be a smokeproof enclosure or pressurized stairway in accordance with Section 7.9.20.
- 8.19.1.8.1 Enclosure exit.** A smokeproof enclosure or pressurized stairway shall exit into a public way or into an exit passageway, yard or open space having direct access to a public way. The exit passageway shall be without other openings and shall be separated from the remainder of the building by 2-hour fire-resistance-rated construction.
- Exceptions:**
1. Openings in the exit passageway serving a smokeproof enclosure are permitted where the exit passageway is protected and pressurized in the same manner as the smokeproof enclosure, and openings are protected as required for access from other floors.
  2. Openings in the exit passageway serving a pressurized stairway are permitted where the exit passageway is protected and pressurized in the same manner as the pressurized stairway.
- 8.19.1.8.2 Enclosure access.** Access to the stairway within a smokeproof enclosure shall be by way of a vestibule or an open exterior balcony.
- Exception:** Access is not required by way of a vestibule or exterior balcony for stairways using the pressurization alternative complying with Section 7.9.20.5.

## SECTION 8.20 EXIT PASSAGEWAYS

- 8.20.1 Exit passageway.** Exit passageways serving as an exit component in a means of egress system shall comply with the requirements of this section. An exit passageway shall not be used for any purpose other than as a means of egress.
- 8.20.2 Width.** The width of exit passageways shall be determined as specified in Section 8.5.1 but such width shall not be less than 1.1 m, except that exit passageways serving an occupant load of less than 50 shall not be less than 900 mm in width. The required width of exit passageways shall be unobstructed.
- Exception:** Doors, when fully opened, and handrails, shall not reduce the required width by more than 180 mm. Doors in any position shall not reduce the required width by more than one-half. Other nonstructural projections such as trim and similar decorative features are permitted to project into the required width 38 mm on each side.
- 8.20.3 Construction.** Exit passageway enclosures shall have walls, floors and ceilings of not less than 1-hour fire-resistance rating, and not less than that required for any

connecting exit enclosure. Exit passageways shall be constructed as fire barriers in accordance with Section 4B.6.

**8.20.4 Openings and penetrations.** Exit passageway opening protectives shall be in accordance with the requirements of Section 4B.15.

Except as permitted in Section 2B.2.4.6, openings in exit passageways other than unexposed exterior openings shall be limited to those necessary for exit access to the exit passageway from normally occupied spaces and for egress from the exit passageway.

Where interior exit enclosures are extended to the exterior of a building by an exit passageway, the door assembly from the exit enclosure to the exit passageway shall be protected by a fire door conforming to the requirements in Section 4B.15.3. Fire door assemblies in exit passageways shall comply with Section 4B.15.3.4.

Elevators shall not open into an exit passageway.

**8.20.5 Penetrations.** Penetrations into and openings through an exit passageway are prohibited except for required exit doors, equipment and ductwork necessary for independent pressurization, sprinkler piping, standpipes, electrical raceway for fire department communication and electrical raceway serving the exit passageway and terminating at a steel box not exceeding  $0.010 \text{ m}^2$ . Such penetrations shall be protected in accordance with Section 4B.12. There shall be no penetrations or communicating openings, whether protected or not, between adjacent exit passageways.

## SECTION 8.21 HORIZONTAL EXITS

**8.21.1 Horizontal exits.** Horizontal exits serving as an exit in a means of egress system shall comply with the requirements of this section. A horizontal exit shall not serve as the only exit from a portion of a building, and where two or more exits are required, not more than one-half of the total number of exits or total exit width shall be horizontal exits.

**Exceptions:**

1. Horizontal exits are permitted to comprise two-thirds of the required exits from any building or floor area for occupancies in Group I-2.
2. Horizontal exits are permitted to comprise 100 percent of the exits required for occupancies in Group I-3. At least  $0.6 \text{ m}^2$  of accessible space per occupant shall be provided on each side of the horizontal exit for the total number of people in adjoining compartments.

Every fire compartment for which credit is allowed in connection with a horizontal exit shall not be required to have a stairway or door leading directly outside, provided the adjoining fire compartments have stairways or doors leading directly outside and are so arranged that egress shall not require the occupants to return through the compartment from which egress originates.

The area into which a horizontal exit leads shall be provided with exits adequate to meet the occupant requirements of this chapter, but not including the added occupant capacity imposed by persons entering it through horizontal exits from another area. At least one of its exits shall lead directly to the exterior or to an exit enclosure.

- 8.21.2 Separation.** The separation between buildings or areas of refuge connected by a horizontal exit shall be provided by a fire wall complying with Section 4B.5 or a fire barrier complying with Section 4B.6 and having a fire-resistance rating of not less than 2 hours. Opening protectives in horizontal exit walls shall also comply with Section 4B.15. The horizontal exit separation shall extend vertically through all levels of the building unless floor assemblies are of 2-hour fire resistance with no unprotected openings.
- Exception:** A fire-resistance rating is not required at horizontal exits between a building area and an above-grade pedestrian walkway constructed in accordance with Section 4.4.4 of the SBC 201, provided that the distance between connected buildings is more than 6.1 m.
- Horizontal exit walls constructed as fire barriers shall be continuous from exterior wall to exterior wall so as to divide completely the floor served by the horizontal exit.
- 8.21.3 Opening protectives.** Fire doors in horizontal exits shall be self-closing or automatic-closing when activated by a smoke detector installed in accordance with Section 7.7.11. Opening protectives in horizontal exits shall be consistent with the fire-resistance rating of the wall. Such doors where located in a cross-corridor condition shall be automatic-closing by activation of a smoke detector installed in accordance with Section 7.7.11.
- 8.21.4 Capacity of refuge area.** The refuge area of a horizontal exit shall be spaces occupied by the same tenant or public areas and each such area of refuge shall be adequate to house the original occupant load of the refuge space plus the occupant load anticipated from the adjoining compartment. The anticipated occupant load from the adjoining compartment shall be based on the capacity of the horizontal exit doors entering the area of refuge. The capacity of areas of refuge shall be computed on a net floor area allowance of  $0.2787 \text{ m}^2$  for each occupant to be accommodated therein, not including areas of stairways, elevators and other shafts or courts.
- Exception:** The net floor area allowable per occupant shall be as follows for the indicated occupancies:
1.  $0.6 \text{ m}^2$  per occupant for occupancies in Group I-3.
  2.  $1.4 \text{ m}^2$  per occupant for ambulatory occupancies in Group I-2.
  3.  $2.8 \text{ m}^2$  per occupant for nonambulatory occupancies in Group I-2.

## SECTION 8.22

### EXTERIOR EXIT RAMPS AND STAIRWAYS

- 8.22.1 Exterior exit ramps and stairways.** Exterior exit ramps and stairways serving as an element of a required means of egress shall comply with this section.
- Exception:** Exterior exit ramps and stairways for outdoor stadiums complying with Section 8.19.1, Exception 2.
- 8.22.2 Use in a means of egress.** Exterior exit ramps and stairways shall not be used as an element of a required means of egress for occupancies in Group I-2. For occupancies in other than Group I-2, exterior exit ramps and stairways shall be permitted as an element of a required means of egress for buildings not exceeding six stories or 23 m in height.

- 8.22.3 Open side.** Exterior exit ramps and stairways serving as an element of a required means of egress shall be open on at least one side. An open side shall have a minimum of  $3.3 \text{ m}^2$  of aggregate open area adjacent to each floor level and the level of each intermediate landing. The required open area shall be located not less than 1.1 m above the adjacent floor or landing level.
- 8.22.4 Side yards.** The open areas adjoining exterior exit ramps or stairways shall be either yards, courts or public ways; the remaining sides are permitted to be enclosed by the exterior walls of the building.
- 8.22.5 Location.** Exterior exit ramps and stairways shall be located in accordance with Section 8.23.3.
- 8.22.6 Exterior ramps and stairway protection.** Exterior exit ramps and stairways shall be separated from the interior of the building as required in Section 8.19.1. Openings shall be limited to those necessary for egress from normally occupied spaces.

**Exceptions:**

1. Separation from the interior of the building is not required for occupancies, other than those in Group R-1 or R-2, in buildings that are no more than two stories above grade where the level of exit discharge is the first story above grade.
2. Separation from the interior of the building is not required where the exterior ramp or stairway is served by an exterior ramp and/or balcony that connects two remote exterior stairways or other approved exits, with a perimeter that is not less than 50 percent open. To be considered open, the opening shall be a minimum of 50 percent of the height of the enclosing wall, with the top of the openings no less than 2.1 m above the top of the balcony.
3. Separation from the interior of the building is not required for an exterior ramp or stairway located in a building or structure that is permitted to have unenclosed interior stairways in accordance with Section 8.19.1.
4. Separation from the interior of the building is not required for exterior ramps or stairways connected to open-ended corridors, provided that items 4.1 through 4.4 are met:
  - 4.1 The building, including corridors and ramps and/or stairs, shall be equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.
  - 4.2 The open-ended corridors comply with Section 8.16.
  - 4.3 The open-ended corridors are connected on each end to an exterior exit ramp or stairway complying with Section 8.22.
  - 4.4 At any location in an open-ended corridor where a change of direction exceeding 45 degrees (0.79 rad) occurs, a clear opening of not less than  $3.3 \text{ m}^2$  or an exterior ramp or stairway shall be provided. Where clear openings are provided, they shall be located so as to minimize the accumulation of smoke or toxic gases.

## SECTION 8.23

### EXIT DISCHARGE

**8.23.1 General.** Exits shall discharge directly to the exterior of the building. The exit discharge shall be at grade or shall provide direct access to grade. The exit discharge shall not reenter a building.

**Exceptions:**

1. A maximum of 50 percent of the number and capacity of the exit enclosures is permitted to egress through areas on the level of discharge provided all of the following are met:
  - 1.1 Such exit enclosures egress to a free and unobstructed way to the exterior of the building, which way is readily visible and identifiable from the point of termination of the exit enclosure.
  - 1.2 The entire area of the level of discharge is separated from areas below by construction conforming to the fire-resistance rating for the exit enclosure.
  - 1.3 The egress path from the exit enclosure on the level of discharge is protected throughout by an approved automatic sprinkler system. All portions of the level of discharge with access to the egress path shall either be protected throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2, or separated from the egress path in accordance with the requirements for the enclosure of exits.
2. A maximum of 50 percent of the number and capacity of the exit enclosures is permitted to egress through a vestibule provided all of the following are met:
  - 2.1 The entire area of the vestibule is separated from areas below by construction conforming to the fire-resistance rating for the exit enclosure.
  - 2.2 The depth from the exterior of the building is not greater than 3.1 m and the length is not greater than 9.1 m.
  - 2.3 The area is separated from the remainder of the level of exit discharge by construction providing protection at least the equivalent of approved wired glass in steel frames.
  - 2.4 The area is used only for means of egress and exits directly to the outside.
3. Stairways in open parking garages complying with Section 8.19.1, Exception 5, are permitted to egress through the open parking garage at the level of exit discharge.

**8.23.2 Exit discharge capacity.** The capacity of the exit discharge shall be not less than the required discharge capacity of the exits being served.

**8.23.3 Exit discharge location.** Exterior balconies, stairways and ramps shall be located at least 3.1 m from adjacent lot lines and from other buildings on the same lot unless the adjacent building exterior walls and openings are protected in accordance with Section 4B.4 based on fire separation distance.

**8.23.4 Exit discharge components.** Exit discharge components shall be sufficiently open to the exterior so as to minimize the accumulation of smoke and toxic gases.

**8.23.5 Egress courts.** Egress courts serving as a portion of the exit discharge in the means of egress system shall comply with the requirements of Section 8.23.

**8.23.5.1 Width.** The width of egress courts shall be determined as specified in Section 8.5.1, but such width shall not be less than 1.1 m, except as specified herein. Egress courts serving occupancies in Group R-3 applicable in Section 8.1.1 and Group U shall not be less than 900 mm in width.

The required width of egress courts shall be unobstructed to a height of 2.1 m.

**Exception:** Doors, when fully opened and handrails shall not reduce the required width by more than 180 mm. Doors in any position shall not reduce the required width by more than one-half. Other nonstructural projections such as trim and similar decorative features are permitted to project into the required width 38 mm from each side.

Where an egress court exceeds the minimum required width and the width of such egress court is then reduced along the path of exit travel, the reduction in width shall be gradual. The transition in width shall be affected by a guard not less than 900 mm in height and shall not create an angle of more than 30 degrees (0.52 rad) with respect to the axis of the egress court along the path of egress travel. In no case shall the width of the egress court be less than the required minimum.

**8.23.5.2 Construction and openings.** Where an egress court serving a building or portion thereof is less than 3.1 m in width, the egress court walls shall be not less than 1-hour fire-resistance-rated exterior walls complying with Section 4B.4 for a distance of 3.1 m above the floor of the court, and openings therein shall be equipped with fixed or self-closing,  $3/4$  hour opening protective assemblies.

**Exceptions:**

1. Egress courts serving an occupant load of less than 10.
2. Egress courts serving Group R-3 as applicable in Section 8.1.1.

**8.23.6 Access to a public way.** The exit discharge shall provide a direct and unobstructed access to a public way.

**Exception:** Where access to a public way cannot be provided, a safe dispersal area shall be provided where all of the following are met:

1. The area shall be of a size to accommodate at least  $0.28 \text{ m}^2$  for each person.
2. The area shall be located on the same property at least 15.3 m away from the building requiring egress.
3. The area shall be permanently maintained and identified as a safe dispersal area.
4. The area shall be provided with a safe and unobstructed path of travel from the building.

## SECTION 8.24 ASSEMBLY

**8.24.1 General.** Occupancies in Group A which contain seats, tables, displays, equipment or other material shall comply with this section.

**8.24.1.1 Bleachers.** Bleachers, grandstands, and folding and telescopic seating shall comply with ICC 300.

**8.24.2 Assembly main exit.** Group A occupancies that have an occupant load of greater than 300 shall be provided with a main exit. The main exit shall be of sufficient width to accommodate not less than one-half of the occupant load, but such width shall not be less than the total required width of all means of egress leading to the exit. Where the building is classified as a Group A occupancy, the main exit shall

front on at least one street or an unoccupied space of not less than 3.1 m in width that adjoins a street or public way.

**Exception:** In assembly occupancies where there is no well-defined main exit or where multiple main exits are provided, exits shall be permitted to be distributed around the perimeter of the building provided that the total width of egress is not less than 100 percent of the required width.

**8.24.3 Assembly other exits.** In addition to having access to a main exit, each level of an occupancy in Group A having an occupant load of greater than 300 shall be provided with additional exits that shall provide an egress capacity for at least one-half of the total occupant load served by that level and comply with Section 8.14.2.

**Exception:** In assembly occupancies where there is no well-defined main exit or where multiple main exits are provided, exits shall be permitted to be distributed around the perimeter of the building provided that the total width of egress is not less than 100 percent of the required width.

**8.24.4 Foyers and lobbies.** In Group A-1 occupancies, where persons are admitted to the building at times when seats are not available and are allowed to wait in a lobby or similar space, such use of lobby or similar space shall not encroach upon the required clear width of the means of egress. Such waiting areas shall be separated from the required means of egress by substantial permanent partitions or by fixed rigid railings not less than 1.1 m high. Such foyer, if not directly connected to a public street by all the main entrances or exits, shall have a straight and unobstructed corridor or path of travel to every such main entrance or exit.

**8.24.5 Interior balcony and gallery means of egress.** For balconies or galleries having a seating capacity of over 50 located in Group A occupancies, at least two means of egress shall be provided, one from each side of every balcony or gallery, with at least one leading directly to an exit.

**8.24.5.1 Enclosure of balcony openings.** Interior stairways and other vertical openings shall be enclosed in a vertical exit enclosure as provided in Section 8.19.1, except that stairways are permitted to be open between the balcony and the main assembly floor in occupancies such as theaters, Mosques and auditoriums. At least one accessible means of egress is required from a balcony or gallery level containing accessible seating locations in accordance with Section 8.7.3 or 8.7.4.

**8.24.6 Width of means of egress for assembly.** The clear width of aisles and other means of egress shall comply with Section 8.24.6.1 where smoke-protected seating is not provided and with Section 8.24.6.2 or 8.24.6.3 where smoke-protected seating is provided. The clear width shall be measured to walls, edges of seating and tread edges except for permitted projections.

**8.24.6.1 Without smoke protection.** The clear width of the means of egress shall provide sufficient capacity in accordance with all of the following, as applicable:

1. At least 7.6 mm of width for each occupant served shall be provided on stairs having riser heights 180 mm or less and tread depths 280 mm or greater, measured horizontally between tread nosing.
2. At least 130 mm of additional stair width for each occupant shall be provided for each 2.5 mm of riser height above 180 mm.
3. Where egress requires stair descent, at least 1.9 mm of additional width for each occupant shall be provided on those portions of stair width having no handrail within a horizontal distance of 760 mm.



4. Ramped means of egress, where slopes are steeper than one unit vertical in 12 units horizontal (8 percent slope), shall have at least 5.6 mm of clear width for each occupant served. Level or ramped means of egress, where slopes are not steeper than one unit vertical in 12 units horizontal (8 percent slope), shall have at least 5.1 mm of clear width for each occupant served.

**8.24.6.2 Smoke-protected seating.** The clear width of the means of egress for smoke-protected assembly seating shall be not less than the occupant load served by the egress element multiplied by the appropriate factor in Table 8.24.6.2. The total number of seats specified shall be those within a single assembly space and exposed to the same smoke-protected environment. Interpolation is permitted between the specific values shown. A life safety evaluation, complying with NFPA 101, shall be done for a facility utilizing the reduced width requirements of Table 8.24.6.2 for smoke-protected assembly seating.

**Exception:** For an outdoor smoke-protected assembly with an occupant load not greater than 18,000, the clear width shall be determined using the factors in Section 8.24.6.3.

**8.24.6.2.1 Smoke control.** Means of egress serving a smoke-protected assembly seating area shall be provided with a smoke control system complying with Section 7.9 or natural ventilation designed to maintain the smoke level at least 1.8 m above the floor of the means of egress.

**8.24.6.2.2 Roof height.** A smoke-protected assembly seating area with a roof shall have the lowest portion of the roof deck not less than 4.6 m above the highest aisle or aisle accessway.

**Exception:** A roof canopy in an outdoor stadium shall be permitted to be less than 4.6 m above the highest aisle or aisle accessway provided that there are no objects less than 2.1 m above the highest aisle or aisle accessway.

**8.24.6.2.3 Automatic sprinklers.** Enclosed areas with walls and ceilings in buildings or structures containing smoke-protected assembly seating shall be protected with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1.

**Exceptions:**

1. The floor area used for contests, performances or entertainment provided the roof construction is more than 15.3 m above the floor level and the use is restricted to low fire hazard uses.
2. Press boxes and storage facilities less than 93 m<sup>2</sup> in area.
3. Outdoor seating facilities where seating and the means of egress in the seating area are essentially open to the outside.

**TABLE 8.24.6.2  
WIDTH OF AISLES FOR SMOKE-PROTECTED ASSEMBLY**

TOTAL NUMBER OF SEATS IN THE SMOKE-PROTECTED ASSEMBLY OCCUPANCY	METERS OF CLEAR WIDTH PER SEAT SERVED			
	Stairs and aisle steps with handrails within 0.76 m	Stairs and aisle steps without handrails within 0.76 m	Passageways, doorways and ramps not steeper than 1 in 10 in slope	Ramps steeper than 1 in 10 in slope
Equal to or less than 5,000	5.1	6.4	3.8	4.2
10,000	3.3	4.1	2.5	2.8
15,000	2.4	3.1	1.8	2
20,000	1.9	2.4	1.4	1.6
Equal to or greater than 25,000	1.5	1.9	1.1	1.2

**8.24.6.3 Width of means of egress for outdoor smoke-protected assembly.** The clear width in millimeters of aisles and other means of egress shall be not less than the total occupant load served by the egress element multiplied by 2.0 mm where egress is by aisles and stairs and multiplied by 1.52 mm where egress is by ramps, corridors, tunnels or vomitories.

**Exception:** The clear width in millimeters of aisles and other means of egress shall be permitted to comply with Section 8.24.6.2 for the number of seats in the outdoor smoke-protected assembly where Section 8.24.6.2 permits less width.

**8.24.7 Travel distance.** Exits and aisles shall be so located that the travel distance to an exit door shall not be greater than 61 m measured along the line of travel in nonsprinklered buildings. Travel distance shall not be more than 76.2 m in sprinklered buildings. Where aisles are provided for seating, the distance shall be measured along the aisles and aisle accessway without travel over or on the seats.

**Exceptions:**

1. Smoke-protected assembly seating: The travel distance from each seat to the nearest entrance to a vomitory or concourse shall not exceed 61 m. The travel distance from the entrance to the vomitory or concourse to a stair, ramp or walk on the exterior of the building shall not exceed 61 m.
2. Open-air seating: The travel distance from each seat to the building exterior shall not exceed 122 m. The travel distance shall not be limited in facilities of Type I or II construction.

**8.24.8 Common path of travel.** The common path of travel shall not exceed 9.1 m from any seat to a point where a person has a choice of two paths of egress travel to two exits.

**Exceptions:**

1. For areas serving not more than 50 occupants, the common path of travel shall not exceed 23 m.
2. For smoke-protected assembly seating, the common path of travel shall not exceed 15.3 m.

**8.24.8.1 Path through adjacent row.** Where one of the two paths of travel is across the aisle through a row of seats to another aisle, there shall be not more than 24 seats between the two aisles, and the minimum clear width between rows for the row between the two aisles shall be 300 mm plus 15.2 mm for each additional seat above seven in the row between aisles.

**Exception:** For smoke-protected assembly seating there shall not be more than 40 seats between the two aisles and the minimum clear width shall be 300 mm plus 7.6 mm for each additional seat.

**8.24.9 Assembly aisles are required.** Every occupied portion of any occupancy in Group A that contains seats, tables, displays, similar fixtures or equipment shall be provided with aisles leading to exits or exit access doorways in accordance with this section. Aisle accessways for tables and seating shall comply with Section 8.13.4.2.

**8.24.9.1 Minimum aisle width.** The minimum clear width of aisles shall be as shown:

1. One thousand two hundred and nineteen millimeters for aisle stairs having seating on each side.

**Exception:** Nine hundred and fourteen millimeters where the aisle does not serve more than 50 seats.

2. Nine hundreds and fourteen millimeters for aisle stairs having seating on only one side.
3. Five hundreds and eighty four millimeters between an aisle stair handrail or guard and seating where the aisle is subdivided by a handrail.
4. One thousand and sixty seven millimeters for level or ramped aisles having seating on both sides.

**Exceptions:**

1. Nine hundreds and fourteen millimeters where the aisle does not serve more than 50 seats.
2. Seven hundreds and sixty two millimeters where the aisle does not serve more than 14 seats.
5. Nine hundreds and fourteen millimeters for level or ramped aisles having seating on only one side.  
**Exception:** Seven hundreds and sixty two millimeters where the aisle does not serve more than 14 seats.
6. Five hundreds and eighty four millimeters between an aisle stair handrail and seating where an aisle does not serve more than five rows on one side.

**8.24.9.2 Aisle width.** The aisle width shall provide sufficient egress capacity for the number of persons accommodated by the catchment area served by the aisle. The catchment area served by an aisle is that portion of the total space that is served by that section of the aisle. In establishing catchment areas, the assumption shall be made that there is a balanced use of all means of egress, with the number of persons in proportion to egress capacity.

**8.24.9.3 Converging aisles.** Where aisles converge to form a single path of egress travel, the required egress capacity of that path shall not be less than the combined required capacity of the converging aisles.

**8.24.9.4 Uniform width.** Those portions of aisles, where egress is possible in either of two directions, shall be uniform in required width.

**8.24.9.5 Assembly aisle termination.** Each end of an aisle shall terminate at cross aisle, foyer, doorway, vomitory or concourse having access to an exit.

**Exceptions:**

1. Dead-end aisles shall not be greater than 6.1 m in length.
2. Dead-end aisles longer than 6.1 m are permitted where seats beyond the 6.1 m dead-end aisle are no more than 24 seats from another aisle, measured along a row of seats having a minimum clear width of 300 mm plus 15.2 mm for each additional seat above seven in the row.
3. For smoke-protected assembly seating, the dead-end aisle length of vertical aisles shall not exceed a distance of 21 rows.
4. For smoke-protected assembly seating, a longer dead-end aisle is permitted where seats beyond the 21-row dead-end aisle are not more than 40 seats from another aisle, measured along a row of seats having an aisle accessway with a minimum clear width of 300 mm plus 7.6 mm for each additional seat above seven in the row.

**8.24.9.6 Assembly aisle obstructions.** There shall be no obstructions in the required width of aisles except for handrails as provided in Section 8.24.13.

**8.24.10 Clear width of aisle accessways serving seating.** Where seating rows have 14 or fewer seats, the minimum clear aisle accessway width shall not be less than 300 mm measured as the clear horizontal distance from the back of the row ahead and the nearest projection of the row behind. Where chairs have automatic or self-rising seats, the measurement shall be made with seats in the raised position.

Where any chair in the row does not have an automatic or self-rising seat, the measurements shall be made with the seat in the down position. For seats with folding tablet arms, row spacing shall be determined with the tablet arm down.

**8.24.10.1 Dual access.** For rows of seating served by aisles or doorways at both ends, there shall not be more than 100 seats per row. The minimum clear width of 300 mm between rows shall be increased by 7.6 mm for every additional seat beyond 14 seats, but the minimum clear width is not required to exceed 560 mm.

**Exception:** For smoke-protected assembly seating, the row length limits for a 300 mm wide aisle accessway, beyond which the aisle accessway minimum clear width shall be increased, are in Table 8.24.10.1.

**TABLE 8.24.10.1  
SMOKE-PROTECTED ASSEMBLY AISLE ACCESSWAYS**

TOTAL NUMBER OF SEATS IN THE SMOKE- PROTECTED ASSEMBLY OCCUPANCY	MAXIMUM NUMBER OF SEATS PER ROW PERMITTED TO HAVE A MINIMUM 0.31 M CLEAR WIDTH AISLE ACCESSWAY	
	Aisle or doorway at both ends of row	Aisle or doorway at one end of row only
Less than 4,000	14	7
4,000	15	7
7,000	16	8
10,000	17	8
13,000	18	9
16,000	19	9
19,000	20	10
22,000 and greater	21	11

**8.24.10.2 Single access.** For rows of seating served by an aisle or doorway at only one end of the row, the minimum clear width of 300 mm between rows shall be increased by 15.2 mm for every additional seat beyond seven seats, but the minimum clear width is not required to exceed 560 mm.

**Exception:** For smoke-protected assembly seating, the row length limits for a 300 mm wide aisle accessway, beyond which the aisle accessway minimum clear width shall be increased, are in Table 8.24.10.1.

**8.24.11 Assembly aisle walking surfaces.** Aisles with a slope not exceeding one unit vertical in eight units horizontal (12.5 percent slope) shall consist of a ramp having a slip-resistant walking surface. Aisles with a slope exceeding one unit vertical in eight units horizontal (12.5 percent slope) shall consist of a series of risers and treads that extends across the full width of aisles and complies with Sections 8.24.11.1 through 8.24.11.3.

**8.24.11.1 Treads.** Tread depths shall be a minimum of 280 mm and shall have dimensional uniformity.

**Exception:** The tolerance between adjacent treads shall not exceed 4.8 mm.

**8.24.11.2 Risers.** Where the gradient of aisle stairs is to be the same as the gradient of adjoining seating areas, the riser height shall not be less than 100 mm nor more than 200 mm and shall be uniform within each flight.

**Exceptions:**

1. Riser height non-uniformity shall be limited to the extent necessitated by changes in the gradient of the adjoining seating area to maintain adequate

sightlines. Where non-uniformities exceed 4.8 mm between adjacent risers, the exact location of such non-uniformities shall be indicated with a distinctive marking stripe on each tread at the nosing or leading edge adjacent to the non-uniform risers. Such stripe shall be a minimum of 25 mm, and a maximum of 51 mm, wide. The edge marking stripe shall be distinctively different from the contrasting marking stripe.

2. Riser heights not exceeding 230 mm shall be permitted where they are necessitated by the slope of the adjacent seating areas to maintain sightlines.

**8.24.11.3 Tread contrasting marking stripe.** A contrasting marking stripe shall be provided on each tread at the nosing or leading edge such that the location of each tread is readily apparent when viewed in descent. Such stripe shall be a minimum of 25 mm, and a maximum of 50 mm, wide.

**Exception:** The contrasting marking stripe is permitted to be omitted where tread surfaces are such that the location of each tread is readily apparent when viewed in descent.

**8.24.12 Seat stability.** In places of assembly, the seats shall be securely fastened to the floor.

**Exceptions:**

1. In places of assembly or portions thereof without ramped or tiered floors for seating and with 200 or fewer seats, the seats shall not be required to be fastened to the floor.
2. In places of assembly or portions thereof with seating at tables and without ramped or tiered floors for seating, the seats shall not be required to be fastened to the floor.
3. In places of assembly or portions thereof without ramped or tiered floors for seating and with greater than 200 seats, the seats shall be fastened together in groups of not less than three or the seats shall be securely fastened to the floor.
4. In places of assembly where flexibility of the seating arrangement is an integral part of the design and function of the space and seating is on tiered levels, a maximum of 200 seats shall not be required to be fastened to the floor. Plans showing seating, tiers and aisles shall be submitted for approval.
5. Groups of seats within a place of assembly separated from other seating by railings, guards, partial height walls or similar barriers with level floors and having no more than 14 seats per group shall not be required to be fastened to the floor.
6. Seats intended for musicians or other performers and separated by railings, guards, partial height walls or similar barriers shall not be required to be fastened to the floor.

**8.24.13 Handrails.** Ramped aisles having a slope exceeding one unit vertical in 15 units horizontal (6.7 percent slope) and aisle stairs shall be provided with handrails located either at the side or within the aisle width.

**Exceptions:**

1. Handrails are not required for ramped aisles having a gradient no greater than one unit vertical in eight units horizontal (12.5 percent slope) and seating on both sides.
2. Handrails are not required if, at the side of the aisle, there is a guard that complies with the graspability requirements of handrails.

**8.24.13.1 Discontinuous handrails.** Where there is seating on both sides of the aisle, the handrails shall be discontinuous with gaps or breaks at intervals not exceeding five

rows to facilitate access to seating and to permit crossing from one side of the aisle to the other. These gaps or breaks shall have a clear width of at least 560 mm and not greater than 900 mm, measured horizontally, and the handrail shall have rounded terminations or bends.

- 8.24.13.2 Intermediate handrails.** Where handrails are provided in the middle of aisle stairs, there shall be an additional intermediate handrail located approximately 300 mm below the main handrail.

- 8.24.14 Assembly guards.** Assembly guards shall comply with Sections 8.24.14.1 through 8.24.14.3.

- 8.24.14.1 Cross aisles.** Cross aisles located more than 760 mm above the floor or grade below shall have guards in accordance with Section 8.12.

Where an elevation change of 760 mm or less occurs between a cross aisle and the adjacent floor or grade below, guards not less than 660 mm above the aisle floor shall be provided.

**Exception:** Where the backs of seats on the front of the cross aisle project 660 mm or more above the adjacent floor of the aisle, a guard need not be provided.

- 8.24.14.2 Sightline-constrained guard heights.** Unless subject to the requirements of Section 8.24.14.3, a fascia or railing system in accordance with the guard requirements of Section 8.12 and having a minimum height of 660 mm shall be provided where the floor or footboard elevation is more than 760 mm above the floor or grade below and the fascia or railing would otherwise interfere with the sightlines of immediately adjacent seating. At bleachers, a guard must be provided where the floor or foot-board elevation is more than 600 mm above the floor or grade below and the fascia or railing would otherwise interfere with the sightlines of the immediately adjacent seating.

- 8.24.14.3 Guards at the end of aisles.** A fascia or railing system complying with the guard requirements of Section 8.12 shall be provided for the full width of the aisle where the foot of the aisle is more than 760 mm above the floor or grade below. The fascia or railing shall be a minimum of 900 mm high and shall provide a minimum 1.1 m measured diagonally between the top of the rail and the nosing of the nearest tread.

- 8.24.15 Bench seating.** Where bench seating is used, the number of persons shall be based on one person for each 460 mm of length of the bench.

## SECTION 8.25 EMERGENCY ESCAPE AND RESCUE

- 8.25.1 General.** In addition to the means of egress required by this chapter, provisions shall be made for emergency escape and rescue in Group R as applicable in Section 8.1.1 and Group I-1 occupancies. Basements and sleeping rooms below the fourth story above grade plane shall have at least one exterior emergency escape and rescue opening in accordance with this section. Where basements contain one or more sleeping rooms, emergency egress and rescue openings shall be required in each sleeping room, but shall not be required in adjoining areas of the basement. Such opening shall open directly into a public street, public alley, yard or court.

**Exceptions:**

1. In other than Group R-3 occupancies as applicable in Section 8.1.1, buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.
2. In other than Group R-3 occupancies as applicable in Section 8.1.1, sleeping rooms provided with a door to a fire-resistance-rated corridor having access to two remote exits in opposite directions.
3. The emergency escape and rescue opening is permitted to open onto a balcony within an atrium in accordance with the requirements of Section 2B.4, provided the balcony provides access to an exit and the dwelling unit or sleeping unit has a means of egress that is not open to the atrium.
4. Basements with a ceiling height of less than 2.1 m shall not be required to have emergency escape and rescue windows.
5. High-rise buildings in accordance with Section 2B.3.
6. Emergency escape and rescue openings are not required from basements or sleeping rooms which have an exit door or exit access door that opens directly into a public street, public alley, yard, egress court or to an exterior exit balcony that opens to a public street, public alley, yard or egress court.
7. Basements without habitable spaces and having no more than 18.6 square meters in floor area shall not be required to have emergency escape windows.

**8.25.2 Minimum size.** Emergency escape and rescue openings shall have a minimum net clear opening of  $0.53 \text{ m}^2$ .

**Exception:** The minimum net clear opening for emergency escape and rescue grade-floor openings shall be  $0.46 \text{ m}^2$ .

**8.25.2.1 Minimum dimensions.** The minimum net clear opening height dimension shall be 600 mm. The minimum net clear opening width dimension shall be 500 mm. The net clear opening dimensions shall be the result of normal operation of the opening.

**8.25.3 Maximum height from floor.** Emergency escape and rescue openings shall have the bottom of the clear opening not greater than 1.1 m measured from the floor.

**8.25.4 Operational constraints.** Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools. Bars, grilles, grates or similar devices are permitted to be placed over emergency escape and rescue openings provided the minimum net clear opening size complies with Section 8.25.2 and such devices shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the escape and rescue opening. Where such bars, grilles, grates or similar devices are installed in existing buildings, smoke alarms shall be installed in accordance with Section 7.7.2.10 regardless of the valuation of the alteration.

**8.25.5 Window wells.** An emergency escape and rescue opening with a finished sill height below the adjacent ground level shall be provided with a window well in accordance with Sections 8.25.5.1 and 8.25.5.2.

**8.25.5.1 Minimum size.** The minimum horizontal area of the window well shall be  $0.84 \text{ m}^2$ , with a minimum dimension of 900 mm. The area of the window well shall allow the emergency escape and rescue opening to be fully opened.

- 8.25.5.2 Ladders or steps.** Window wells with a vertical depth of more than 1.1 m shall be equipped with an approved permanently affixed ladder or steps. Ladders or rungs shall have an inside width of at least 300 mm, shall project at least 76 mm from the wall and shall be spaced not more than 460 mm on center (o.c.) vertically for the full height of the window well. The ladder or steps shall not encroach into the required dimensions of the window well by more than 150 mm. The ladder or steps shall not be obstructed by the emergency escape and rescue opening. Ladders or steps required by this section are exempt from the stairway requirements of Section 8.9.

## SECTION 8.26

### MEANS OF EGRESS FOR EXISTING BUILDINGS

- 8.26.1 General.** Means of egress in existing buildings shall comply with Sections 8.3 through 8.25, except as amended in Section 8.26.  
**Exception:** Means of egress conforming to the requirements of the building code under which they were constructed shall be considered as complying means of egress if, in the opinion of the building code official, they do not constitute a distinct hazard to life.
- 8.26.2 Elevators, escalators and moving walks.** Elevators, escalators and moving walks shall not be used as a component of a required means of egress.  
**Exceptions:**
1. Elevators used as an accessible means of egress where allowed by Section 8.7.4.
  2. Previously approved escalators and moving walks in existing buildings.
- 8.26.3 Exit sign illumination.** Exit signs shall be internally or externally illuminated. The face of an exit sign illuminated from an external source, shall have an intensity of not less than 54 lux. Internally illuminated signs shall provide equivalent luminance and be listed for the purpose.  
**Exception:** Approved self-luminous signs that provide evenly illuminated letters shall have a minimum luminance of 0.21 cd/m<sup>2</sup>.
- 8.26.4 Power source.** Where emergency illumination is required in Section 8.26.5, exit signs shall be visible under emergency illumination conditions.  
**Exception:** Approved signs that provide continuous illumination independent of external power sources are not required to be connected to an emergency electrical system.
- 8.26.5 Illumination emergency power.** The power supply for means of egress illumination shall normally be provided by the premises' electrical supply. In the event of power supply failure, illumination shall be automatically provided from an emergency system for the following occupancies where such occupancies require two or more means of egress:
1. Group A having more than 50 occupants.  
**Exception:** Assembly occupancies used exclusively as a place of worship and having an occupant load of less than 300.
  2. Group B buildings three or more stories in height, buildings with 100 or more occupants above or below the level of exit discharge, or buildings with 1,000 or more total occupants.



3. Group E in interior stairs, corridors, windowless areas with student occupancy, shops and laboratories.
4. Group F having more than 100 occupants.  
**Exception:** Buildings used only during daylight hours which are provided with windows for natural light in accordance with the SBC 210.
5. Group I.
6. Group M.  
**Exception:** Buildings less than 279 m<sup>2</sup> in gross sales area on one story only, excluding mezzanines.
7. Group R-1.  
**Exception:** Where each guestroom has direct access to the outside of the building at grade.
8. Group R-2 as applicable in Section 8.1.1.  
**Exception:** Where each living unit has direct access to the outside of the building at grade.
9. Group R-4.  
**Exception:** Where each sleeping room has direct access to the outside of the building at ground level.

The emergency power system shall provide power for not less than 60 minutes and consist of storage batteries, unit equipment or an on-site generator. The installation of the emergency power system shall be in accordance with Section 5D.4.

**8.26.6 Guards.** Guards complying with this section shall be provided at the open sides of means of egress that are more than 760 mm above the floor or grade below.

**8.26.6.1 Height of guards.** Guards shall form a protective barrier not less than 1.1 m high.  
**Exceptions:**

1. Existing guards on the open side of stairs shall be not less than 760 mm high.
2. Existing guards within dwelling units shall be not less than 900 mm high.
3. Existing guards in assembly seating areas.

**8.26.6.2 Opening limitations.** Open guards shall have balusters or ornamental patterns such that a 150 mm diameter sphere cannot pass through any opening up to a height of 860 mm.

**Exceptions:**

1. At elevated walking surfaces for access to, and use of electrical, mechanical or plumbing systems or equipment, guards shall have balusters or be of solid materials such that a sphere with a diameter of 530 mm cannot pass through any opening.
2. In occupancies in Group I-3, F, H or S, the clear distance between intermediate rails measured at right angles to the rails shall not exceed 530 mm.
3. Approved existing open guards.

**8.26.7 Size of doors.** The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 700 mm. Where this section requires a minimum clear width of 700 mm and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 700 mm. The maximum width of a swinging door leaf shall be 1.2 m nominal. Means of egress doors in an occupancy in Group I-2 used for the movement of beds shall provide a clear width not less than 1.1 m. The height of doors shall not be less than 2.1 m.

**Exceptions:**

1. The minimum and maximum width shall not apply to door openings that are not part of the required means of egress in occupancies in Groups R-2 and R-3 as applicable in Section 8.1.1.
2. Door openings to storage closets less than  $0.93 \text{ m}^2$  in area shall not be limited by the minimum width.
3. Width of door leaves in revolving doors that comply with Section 8.3.3.1.3.1 shall not be limited.
4. Door openings within a dwelling unit shall not be less than 2.0 m in height.
5. Exterior door openings in dwelling units, other than the required exit door, shall not be less than 1.9 m in height.
6. Exit access doors serving a room not larger than  $6.5 \text{ m}^2$  shall be not less than 600 mm in door width.

**8.26.8 Opening force for doors.** The opening force for interior side-swinging doors without closers shall not exceed a 22 N force. For other side-swinging, sliding and folding doors, the door latch shall release when subjected to a force of not more than 66 N. The door shall be set in motion when subjected to a force not exceeding a 133 N force. The door shall swing to a full-open position when subjected to a force of not more than 222 N. Forces shall be applied to the latch side.

**8.26.9 Revolving doors.** Revolving doors shall comply with the following:

1. A revolving door shall not be located within 3.1 m of the foot or top of stairs or escalators. A dispersal area shall be provided between the stairs or escalators and the revolving doors.
2. The revolutions per minute for a revolving door shall not exceed those shown in Table 8.26.9.
3. Each revolving door shall have a conforming side-hinged swinging door in the same wall as the revolving door and within 3.1 m.

**Exceptions:**

1. A revolving door is permitted to be used without an adjacent swinging door for street floor elevator lobbies provided a stairway, escalator or door from other parts of the building does not discharge through the lobby and the lobby does not have any occupancy or use other than as a means of travel between elevators and a street.
2. Existing revolving doors where the number of revolving doors does not exceed the number of swinging doors within 6.1 m.

**TABLE 8.26.9  
REVOLVING DOOR SPEEDS**

<b>INSIDE DIAMETER (m)</b>	<b>POWER-DRIVEN- TYPE SPEED CONTROL (RPM)</b>	<b>MANUAL-TYPE SPEED CONTROL (RPM)</b>
1.98	11	12
2.13	10	11
2.3	9	11
2.44	9	10
2.6	8	9
2.74	8	9
2.9	7	8
3.1	7	8

- 8.26.9.1 Egress component.** A revolving door used as a component of a means of egress shall comply with Section 8.26.9 and all of the following conditions:
1. Revolving doors shall not be given credit for more than 50 percent of the required egress capacity.
  2. Each revolving door shall be credited with not more than a 50-person capacity.
  3. Revolving doors shall be capable of being collapsed when a force of not more than 578 N is applied within 76 mm of the outer edge of a wing.
- 8.26.10 Stair dimensions for existing stairs.** Existing stairs in buildings shall be permitted to remain if the rise does not exceed 200 mm and the run is not less than 230 mm. Existing stairs can be rebuilt.  
**Exception:** Other stairs approved by the building code official.
- 8.26.10.1 Stair dimensions for replacement stairs.** The replacement of an existing stairway in a structure shall not be required to comply with the new stairway requirements of Section 8.9 where the existing space and construction will not allow a reduction in pitch or slope.
- 8.26.11 Winders.** Existing winders shall be allowed to remain in use if they have a minimum tread depth of 150 mm and a minimum tread depth of 230 mm at a point 300 mm from the narrowest edge.
- 8.26.12 Circular stairways.** Existing circular stairs shall be allowed to continue in use provided the minimum depth of tread is 250 mm and the smallest radius shall not be less than twice the width of the stairway.
- 8.26.13 Stairway handrails.** Stairways shall have handrails on at least one side. Handrails shall be located so that all portions of the stairway width required for egress capacity are within 1.1 m of a handrail.  
**Exception:** Aisle stairs provided with a center handrail are not required to have additional handrails.
- 8.26.13.1 Height.** Handrail height, measured above stair tread nosings, shall be uniform, not less than 760 mm and not more than 1.1 m.
- 8.26.14 Slope of ramps.** Ramp runs utilized as part of a means of egress shall have a running slope not steeper than one unit vertical in ten units horizontal (10 percent slope). The slope of other ramps shall not be steeper than one unit vertical in eight units horizontal (12.5 percent slope).
- 8.26.15 Width of ramps.** Existing ramps are permitted to have a minimum width of 760 mm but not less than the width required for the number of occupants served as determined by Section 8.5.1.
- 8.26.16 Fire escape stairs.** Fire escape stairs shall comply with Sections 8.26.16.1 through 8.26.16.7.
- 8.26.16.1 Existing means of egress.** Fire escape stairs shall be permitted in existing buildings but shall not constitute more than 50 percent of the required exit capacity.
- 8.26.16.2 Protection of openings.** Openings within 3.1 m of fire escape stairs shall be protected by fire assemblies having a minimum 3/4-hour fire-resistance rating.  
**Exception:** In buildings equipped throughout with an approved automatic sprinkler system, opening protection is not required.

- 8.26.16.3 Dimensions.** Fire escape stairs shall meet the minimum width, capacity, riser height and tread depth as specified in Section 8.26.10.
- 8.26.16.4 Access.** Access to a fire escape from a corridor shall not be through an intervening room. Access to a fire escape stair shall be from a door or window meeting the criteria of Table 8.5.1. Access to a fire escape stair shall be directly to a balcony, landing or platform. These shall be no higher than the floor or window sill level and no lower than 200 mm below the floor level or 460 mm below the window sill.
- 8.26.16.5 Materials and strength.** Components of fire escape stairs shall be constructed of noncombustible materials.  
Fire escape stairs and balconies shall support the dead load plus a live load of not less than  $4.78 \text{ kN/m}^2$ . Fire escape stairs and balconies shall be provided with a top and intermediate handrail on each side. The building code official is authorized to require testing or other satisfactory evidence that an existing fire escape stair meets the requirements of this section.
- 8.26.16.6 Termination.** The lowest balcony shall not be more than 5.5 m from the ground. Fire escape stairs shall extend to the ground or be provided with counter-balanced stairs reaching the ground.  
**Exception:** For fire escape stairs serving 10 or fewer occupants, an approved fire escape ladder is allowed to serve as the termination for a fire escape stairs.
- 8.26.16.7 Maintenance.** Fire escapes shall be kept clear and unobstructed at all times and shall be maintained in good working order.
- 8.26.17 Corridors.** Corridors serving an occupant load greater than 30 and the openings therein shall provide an effective barrier to resist the movement of smoke. Transoms, louvers, doors and other openings shall be closed or be self-closing.  
**Exceptions:**
1. Corridors in occupancies other than in Group H, which are equipped throughout with an approved automatic sprinkler system.
  2. Patient room doors in corridors in occupancies in Group I-2 where smoke barriers are provided in accordance with the SBC 201.
  3. Corridors in occupancies in Group E where each room utilized for instruction or assembly has at least one-half of the required means of egress doors opening directly to the exterior of the building at ground level.
  4. Corridors that are in accordance with the SBC 201.
- 8.26.17.1 Corridor openings.** Openings in corridor walls shall comply with the requirements of the SBC 201.  
**Exceptions:**
1. Where 20-minute fire assemblies are required, solid wood doors at least 44 mm thick or insulated steel doors are permitted.
  2. Openings protected with fixed wire glass set in steel frames.
  3. Openings covered with 12.7 mm gypsum wallboard or 19.1 mm plywood on the room side.
  4. Opening protection is not required if the building is equipped throughout with an approved automatic sprinkler system.
- 8.26.17.2 Dead ends.** Where more than one exit or exit access doorway is required, the exit access shall be arranged such that dead ends do not exceed the limits specified in Table 8.26.17.2.  
**Exception:** A dead-end passageway or corridor shall not be limited in length where the length of the dead-end passageway or corridor is less than 2.5 times the least width of the dead-end passageway or corridor.

**TABLE 8.26.17.2**  
**COMMON PATH, DEAD-END AND TRAVEL DISTANCE LIMITS**  
**(by occupancy)**

OCCUPANCY	COMMON PATH LIMIT		DEAD-END LIMIT		TRAVEL DISTANCE LIMIT	
	Unsprinklered (meters)	Sprinklered (meters)	Unsprinklered (meters)	Sprinklered (meters)	Unsprinklered (meters)	Sprinklered (meters)
Group A	6.1/23 <sup>a</sup>	6.1/23 <sup>a</sup>	6.1 <sup>b</sup>	6.1 <sup>b</sup>	61	76.2
Group B	23	30.5	15.3	15.3	61	76.2
Group E	23	23	6.1	6.1	61	76.2
Groups F-1, S-1 <sup>d</sup>	23	30.5	15.3	15.3	61	76.2
Groups F-2, S-2 <sup>d</sup>	23	30.5	15.3	15.3	91.5	122
Group H-1	7.6	7.6	0	0	23	23
Group H-2	15.3	30.5	0	0	23	30.5
Group H-3	15.3	30.5	6	6.1	30.5	45.7
Group H-4	23	23	6.1	6.1	45.7	53.3
Group H-5	23	23	6.1	15.3	45.7	61
Group I-1	23	23	6.1	6.1	61	76.2
Group I-2 (Health Care)	NR	NR	NR	NR	45.7	61 <sup>c</sup>
Group I-3 (Detention and Correctional—Use Conditions II, III, IV, V)	30.5	30.5	NR	NR	45.7 <sup>c</sup>	61 <sup>c</sup>
Group I-4 (Day Care Centers)	NR	NR	6.1	6.1	61	76.2
Group M (Covered Mall)	23	30.5	15.3	15.3	61	122
Group M (Mercantile)	23	30.5	15.3	15.3	61	76.2
Group R-1 (Hotels)	23	23	15.3	15.3	61	76.2
Group R-2 <sup>e</sup> (Apartments)	23	23	15.3	15.3	61	76.2
Group R-3 <sup>e</sup> (One and Two-Family); Group R-4 (Residential Care/Assisted Living)	NR	NR	NR	NR	NR	NR
Group U	23	23	6.1	6.1	61	76.2

- a. 6.1 meters for common path serving more than 50 persons; 23 meters for common path serving 50 or fewer persons.
  - b. See Section 8.24.9.5 for dead-end aisles in Group A occupancies.
  - c. This dimension is for the total travel distance, assuming incremental portions have fully utilized their allowable maximums. For travel distance within the room, and from the room exit access door to the exit, see the appropriate occupancy chapter.
  - d. See the SBC 201 for special requirements on spacing of doors in aircraft hangars.
  - e. As applicable in Section 8.1.1.
- NR = No requirements.

**8.26.17.3 Exit access travel distance.** Exits shall be located so that the maximum length of exit access travel, measured from the most remote point to an approved exit along the natural and unobstructed path of egress travel, does not exceed the distances given in Table 8.26.17.2.

**8.26.17.4 Common path of egress travel.** The common path of egress travel shall not exceed the distances given Table 8.26.17.2.

**8.26.18 Stairway discharge identification.** A stairway in an exit enclosure which continues below the level of exit discharge shall be arranged and marked to make the direction of egress to a public way readily identifiable.

**Exception:** Stairs that continue one-half story beyond the level of exit discharge need not be provided with barriers where the exit discharge is obvious.

**8.26.19 Exterior stairway protection.** Exterior exit stairs shall be separated from the interior of the building as required in Section 8.22.6. Openings shall be limited to those necessary for egress from normally occupied spaces.

**Exceptions:**

1. Separation from the interior of the building is not required for buildings that are two stories or less above grade where the level of exit discharge is the first story above grade.
2. Separation from the interior of the building is not required where the exterior stairway is served by an exterior balcony that connects two remote exterior stairways or other approved exits, with a perimeter that is not less than 50 percent open. To be considered open, the opening shall be a minimum of 50 percent of the height of the enclosing wall, with the top of the opening not less than 2.1 m above the top of the balcony.
3. Separation from the interior of the building is not required for an exterior stairway located in a building or structure that is permitted to have unenclosed interior stairways in accordance with Section 8.19.1.
4. Separation from the interior of the building is not required for exterior stairways connected to open-ended corridors, provided that:
  - 4.1 The building, including corridors and stairs, is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1 or 7.3.3.1.2.
  - 4.2 The open-ended corridors comply with Section 8.16.
  - 4.3 The open-ended corridors are connected on each end to an exterior exit stairway complying with Section 8.22.1.
  - 4.4 At any location in an open-ended corridor where a change of direction exceeding 45 degrees occurs, a clear opening of not less than 3 m<sup>2</sup> or an exterior stairway shall be provided. Where clear openings are provided, they shall be located so as to minimize the accumulation of smoke or toxic gases.

**8.26.20 Minimum aisles width.** The minimum clear width of aisles shall be:

1. One thousand and sixty seven millimeters for aisle stairs having seating on each side.  
**Exception:** Nine hundreds and fourteen millimeters where the aisle does not serve more than 50 seats.
2. Nine hundreds and fourteen millimeters for stepped aisles having seating on only one side.  
**Exception:** Seven hundreds and sixty millimeters for catchment areas serving not more than 60 seats.
3. Five hundreds and eight millimeters between a stepped aisle handrail or guard and seating when the aisle is subdivided by the handrail.
4. One thousand sixty seven millimeters for level or ramped aisles having seating on both sides.  
**Exception:** Nine hundreds and fourteen millimeters where the aisle does not serve more than 50 seats.
5. Nine hundreds and fourteen millimeters for level or ramped aisles having seating on only one side.  
**Exception:** Seven hundreds and sixty millimeters for catchment areas serving not more than 60 seats.
6. Five hundreds and eighty four millimeters between a stepped stair handrail and seating where an aisle does not serve more than five rows on one side.

**8.26.21 Existing Stairs.** Existing Stairs shall be marked in accordance with Section 8.19.1.7.

**SECTION 8.27**  
**MAINTENANCE OF THE MEANS OF EGRESS**

- 8.27.1 General.** The means of egress for buildings or portions thereof shall be maintained in accordance with this section.
- 8.27.2 Reliability.** Required exit accesses, exits or exit discharges shall be continuously maintained free from obstructions or impediments to full instant use in the case of fire or other emergency. Security devices affecting means of egress shall be subject to approval of the building code official.
- 8.27.3 Obstructions.** A means of egress shall be free from obstructions that would prevent its use, including the accumulation of snow and ice.
- 8.27.4 Furnishings and decorations.** Furnishings, decorations or other objects shall not be placed so as to obstruct exits, access thereto, egress there from, or visibility thereof. Hangings and draperies shall not be placed over exit doors or otherwise be located to conceal or obstruct an exit. Mirrors shall not be placed on exit doors. Mirrors shall not be placed in or adjacent to any exit in such a manner as to confuse the direction of exit.
- 8.27.5 Emergency escape openings.** Required emergency escape openings shall be maintained in accordance with the code in effect at the time of construction, and the following: Required emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools. Bars, grilles, grates or similar devices are allowed to be placed over emergency escape and rescue openings provided the minimum net clear opening size complies with the code that was in effect at the time of construction and such devices shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the escape and rescue opening.





## CHAPTER 9 EXISTING STRUCTURES

### SECTION 9.1 GENERAL

- 9.1.1 Scope.** The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing structures.  
**Exception:** Existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300-02.
- 9.1.2 Maintenance.** Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices or safeguards which are required by Saudi Building Code (SBC 100) shall be maintained in conformance with the code edition under which installed. The owner or the owner's designated agent shall be responsible for the maintenance of buildings and structures. To determine compliance with this subsection, the local building official shall have the authority to require a building or structure to be reinspected. The requirements of this chapter shall not provide the basis for removal or abrogation of fire protection and safety systems and devices in existing structures.
- 9.1.3 Compliance with other codes.** Alterations, repairs, additions and changes of occupancy to existing structures shall comply with the provisions for alterations, repairs, additions and changes of occupancy in these code requirements, SBC 100, SBC 301, SBC 401, SBC 501, and SBC 701.

### SECTION 9.2 DEFINITIONS

- 9.2.1 Definitions.** The following term shall, for the purposes of this chapter and as used elsewhere in the code, have the following meaning:

**TECHNICALLY INFEASIBLE.** An alteration of a building or a facility that has little likelihood of being accomplished because the existing structural conditions require the removal or alteration of a load-bearing member that is an essential part of the structural frame, or because other existing physical or site constraints prohibit modification or addition of elements, spaces or features which are in full and strict compliance with the minimum requirements for new construction and which are necessary to provide accessibility.

### SECTION 9.3 ADDITIONS, ALTERATIONS OR REPAIRS

- 9.3.1 Existing buildings or structures.** Additions or alterations to any building or structure shall conform with the requirements of the code for new construction. Additions or alterations shall not be made to an existing building or structure which will cause the existing building or structure to be in violation of any provisions of SBC 100 requirements. An existing building plus additions shall comply with the height and area provisions of Chapter 3. Portions of the structure not altered and not affected by the alteration are not required to comply with the code requirements for a new structure.

**Exception:** For buildings and structures in flood hazard areas established in SBC 301, any additions, alterations or repairs that constitute substantial improvement of the existing structure, as defined in SBC 301, shall comply with the flood design requirements for new construction and all aspects of the existing structure shall be brought into compliance with the requirements for new construction for flood design.

- 9.3.2 Structural.** Additions or alterations to an existing structure shall not increase the force in any structural element by more than 5 percent, unless the increased forces on the element are still in compliance with the SBC 301 for new structures, nor shall the strength of any structural element be decreased to less than that required by SBC 301 for new structures. Where repairs are made to structural elements of an existing building, and uncovered structural elements are found to be unsound or otherwise structurally deficient, such elements shall be made to conform to the requirements for new structures.
- 9.3.2.1 Existing live load.** Where an existing structure heretofore is altered or repaired, the minimum design loads for the structure shall be the loads applicable at the time of erection, provided that public safety is not endangered thereby.
- 9.3.2.2 Live load reduction.** If the approved live load is less than required by SBC 301, the areas designed for the reduced live load shall be posted in with the approved load. Placards shall be of an approved design.
- 9.3.3 Nonstructural.** Nonstructural alterations or repairs to an existing building or structure are permitted to be made of the same materials of which the building or structure is constructed, provided that they do not adversely affect any structural member or the fire-resistance rating of any part of the building or structure.
- 9.3.4 Stairways.** An alteration or the replacement of an existing stairway in an existing structure shall not be required to comply with the requirements of a new stairway as outlined in Section 8.9 where the existing space and construction will not allow a reduction in pitch or slope.

## SECTION 9.4 FIRE ESCAPES

- 9.4.1 Where permitted.** Fire escapes shall be permitted only as provided for in Sections 9.4.1.1 through 9.4.1.4.
- 9.4.1.1 New buildings.** Fire escapes shall not constitute any part of the required means of egress in new buildings.
- 9.4.1.2 Existing fire escapes.** Existing fire escapes shall be continued to be accepted as a component in the means of egress in existing buildings only.
- 9.4.1.3 New fire escapes.** New fire escapes for existing buildings shall be permitted only where exterior stairs cannot be utilized due to lot lines limiting stair size or due to the sidewalks, alleys or roads at grade level. New fire escapes shall not incorporate ladders or access by windows.
- 9.4.1.4 Limitations.** Fire escapes shall comply with this section and shall not constitute more than 50 percent of the required number of exits nor more than 50 percent of the required exit capacity.
- 9.4.2 Location.** Where located on the front of the building and where projecting beyond the building line, the lowest landing shall not be less than 2.1 m or more than 3.66

m above grade, and shall be equipped with a counterbalanced stairway to the street. In alleyways and thoroughfares less than 9.1 m wide, the clearance under the lowest landing shall not be less than 3.66 m.

- 9.4.3 Construction.** The fire escape shall be designed to support a live load of 4788 Pa and shall be constructed of steel or other approved noncombustible materials. Fire escapes constructed of wood not less than nominal 50 mm thick are permitted on buildings of Type 5 construction. Walkways and railings located over or supported by combustible roofs in buildings of Type 3 and 4 constructions are permitted to be of wood not less than nominal 50 mm thick.
- 9.4.4 Dimensions.** Stairs shall be at least 560 mm wide with risers not more than, and treads not less than, 200 mm and landings at the foot of stairs not less than 1.02 m wide by 900 mm long, located not more than 200 mm below the door.
- 9.4.5 Opening protectives.** Doors and windows along the fire escape shall be protected with 3/4 hour opening protectives.

## SECTION 9.5 GLASS REPLACEMENT

- 9.5.1 Conformance.** The installation or replacement of glass shall be as required for new installations.

## SECTION 9.6 CHANGE OF OCCUPANCY

- 9.6.1 Conformance.** No change shall be made in the use or occupancy of any building that would place the building in a different division of the same group of occupancy or in a different group of occupancies, unless such building is made to comply with the requirements of SBC 100 and SBC 201 for such division or group of occupancy. Subject to the approval of the building official, the use or occupancy of existing buildings shall be permitted to be changed and the building is allowed to be occupied for purposes in other groups without conforming to all the requirements of these code requirements and the SBC 201 for those groups, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.
- 9.6.2 Certificate of occupancy.** A certificate of occupancy shall be issued by local authorized agency where it has been determined that the requirements for the new occupancy classification have been met.
- 9.6.3 Stairways.** Existing stairways in an existing structure shall not be required to comply with the requirements of a new stairway as outlined in Section 8.9 where the existing space and construction will not allow a reduction in pitch or slope.

## SECTION 9.7 HISTORIC BUILDINGS

- 9.7.1 Historic buildings.** The provisions of Saudi Building Code (SBC) relating to the construction, repair, alteration, addition, restoration and movement of structures,

and change of occupancy shall not be mandatory for historic buildings where such buildings are judged by the local building official to not constitute a distinct life safety hazard.

- 9.7.2 Flood hazard areas.** Within flood hazard areas established in accordance with SBC 301, where the work proposed constitutes substantial improvement as defined in SBC 301, the building shall be brought into conformance with SBC 301.

**Exception:** Historic buildings that are:

- a. Listed or preliminarily determined to be eligible for listing in the local Register of Historic Places; or
- b. Determined by authorized local register of historic places as contributing to the historical significance of a registered historic district or a district preliminarily determined to qualify as an historic district; or
- c. Designated as historic under a state or local historic preservation program that is approved by authorized local register of historic places.

## SECTION 9.8 MOVED STRUCTURES

- 9.8.1 Conformance.** Structures moved into or within the jurisdiction shall comply with the provisions of Saudi Building Code (SBC) for new structures.

## SECTION 9.9 ACCESSIBILITY FOR EXISTING BUILDINGS

- 9.9.1 Scope.** The provisions of Sections 9.9.1 through 9.9.8 apply to maintenance, change of occupancy, additions and alterations to existing buildings, including those identified as historic buildings.

**Exception:** Type B dwelling or sleeping units required by Section 9.7 of the SBC 201 are not required to be provided in existing buildings and facilities.

- 9.9.2 Maintenance of facilities.** A building, facility or element that is constructed or altered to be accessible shall be maintained accessible during occupancy.

- 9.9.3 Change of occupancy.** Existing buildings, or portions thereof, that undergo a change of group or occupancy shall have all of the following accessible features:

1. At least one accessible building entrance.
2. At least one accessible route from an accessible building entrance to primary function areas.
3. Signage complying with Section 9.10 of the SBC 201.
4. Accessible parking, where parking is being provided.
5. At least one accessible passenger loading zone, when loading zones are provided.
6. At least one accessible route connecting accessible parking and accessible passenger loading zones to an accessible entrance.

Where it is technically infeasible to comply with the new construction standards for any of these requirements for a change of group or occupancy, the above items shall conform to the requirements to the maximum extent technically feasible. Change of group or occupancy that incorporates any alterations or additions shall comply with this section and Sections 9.9.4, 9.9.5, 9.9.6 and 9.9.7.

- 9.9.4 Additions.** Provisions for new construction shall apply to additions. An addition that affects the accessibility to, or contains an area of primary function, shall comply with the requirements in Section 9.9.6 for accessible routes.
- 9.9.5 Alterations.** A building, facility or element that is altered shall comply with the applicable provisions in Chapter 9 of the SBC 201 and ICC A117.1, unless technically infeasible. Where compliance with this section is technically infeasible, the alteration shall provide access to the maximum extent technically feasible.
- Exceptions:**
1. The altered element or space is not required to be on an accessible route, unless required by Section 9.9.6.
  2. Accessible means of egress required by Chapter 8 are not required to be provided in existing buildings and facilities.
- 9.9.5.1 Extent of application.** An alteration of an existing element, space or area of a building or facility shall not impose a requirement for greater accessibility than that which would be required for new construction.
- Alterations shall not reduce or have the effect of reducing accessibility of a building, portion of a building or facility.
- 9.9.6 Alterations affecting an area containing a primary function.** Where an alteration affects the accessibility to, or contains an area of primary function, the route to the primary function area shall be accessible. The accessible route to the primary function area shall include toilet facilities or drinking fountains serving the area of primary function.
- Exceptions:**
1. The costs of providing the accessible route are not required to exceed 20 percent of the costs of the alterations affecting the area of primary function.
  2. This provision does not apply to alterations limited solely to windows, hardware, operating controls, electrical outlets and signs.
  3. This provision does not apply to alterations limited solely to mechanical systems, electrical systems, installation or alteration of fire protection systems and abatement of hazardous materials.
  4. This provision does not apply to alterations undertaken for the primary purpose of increasing the accessibility of an existing building, facility or element.
- 9.9.7 Scoping for alterations.** The provisions of Sections 9.9.7.1 through 9.9.7.11 shall apply to alterations to existing buildings and facilities.
- 9.9.7.1 Entrances.** Accessible entrances shall be provided in accordance with Section 9.5 of the SBC 201.
- Exception:** Where an alteration includes alterations to an entrance, and the building or facility has an accessible entrance, the altered entrance is not required to be accessible, unless required by Section 9.9.6. Signs complying with Section 9.10 of the SBC 201 shall be provided.
- 9.9.7.2 Elevators.** Altered elements of existing elevators shall comply with ASME A17.1 and ICC A117.1. Such elements shall also be altered in elevators programmed to respond to the same hall call control as the altered elevator.
- 9.9.7.3 Platform lifts.** Platform (wheelchair) lifts complying with ICC A117.1 and installed in accordance with ASME A18.1 shall be permitted as a component of an accessible route.
- 9.9.7.4 Stairs and escalators in existing buildings.** In alterations where an escalator or stair is added where none existed previously, an accessible route shall be provided

in accordance with Sections 9.4.4 and 9.4.5 of the SBC 201.

- 9.9.7.5 Ramps.** Where steeper slopes than allowed by Section 8.10.2 are necessitated by space limitations, the slope of ramps in or providing access to existing buildings or facilities shall comply with Table 9.9.7.5.

**TABLE 9.9.7.5  
RAMPS**

SLOPE	MAXIMUM RISE
Steeper than 1:10 but not steeper than 1:8	76 mm
Steeper than 1:12 but not steeper than 1:10	152 mm

- 9.9.7.6 Performance areas.** Where it is technically infeasible to alter performance areas to be on an accessible route, at least one of each type of performance area shall be made accessible.
- 9.9.7.7 Dwelling or sleeping units.** Where I-1, I-2, I-3, R-1, R-2 or R-4 dwelling or sleeping units are being altered or added, the requirements of Section 9.7 of the SBC 201 for Accessible or Type A units and Chapter 7 for accessible alarms apply only to the quantity of spaces being altered or added.
- 9.9.7.8 Jury boxes and witness stands.** In alterations, accessible wheelchair spaces are not required to be located within the defined area of raised jury boxes or witness stands and shall be permitted to be located outside these spaces where the ramp or lift access restricts or projects into the means of egress.
- 9.9.7.9 Toilet rooms.** Where it is technically infeasible to alter existing toilet and bathing facilities to be accessible, an accessible separate toilet or bathing facility is only permitted if separate scheduled visits for each gender are provided. The unisex facility shall be located on the same floor and in the same area as the existing facilities.
- 9.9.7.10 Dressing, fitting and locker rooms.** Where it is technically infeasible to provide accessible dressing, fitting or locker rooms at the same location as similar types of rooms, one accessible room on the same level shall be provided. Where separate-sex facilities are provided, accessible rooms for each sex shall be provided.
- 9.9.7.11 Check-out aisles.** Where check-out aisles are altered, at least one of each check-out aisle serving each function shall be made accessible until the number of accessible check-out aisles complies with Section 9.9.12.2 of the SBC 201.
- 9.9.7.12 Thresholds.** The maximum height of thresholds at doorways shall be 19.1 mm. Such thresholds shall have beveled edges on each side.
- 9.9.8 Historic buildings.** These provisions shall apply to buildings and facilities designated as historic structures that undergo alterations or a change of occupancy, unless technically infeasible. Where compliance with the requirements for accessible routes, ramps, entrances or toilet facilities would threaten or destroy the historic significance of the building or facility, as determined by the local authority having jurisdiction, the alternative requirements of Sections 9.9.8.1 through 9.9.8.5 for that element shall be permitted.
- 9.9.8.1 Site arrival points.** At least one accessible route from a site arrival point to an accessible entrance shall be provided.
- 9.9.8.2 Multilevel buildings and facilities.** An accessible route from an accessible entrance to public spaces on the level of the accessible entrance shall be provided.
- 9.9.8.3 Entrances.** At least one main entrance shall be accessible.



**Exceptions:**

1. If a main entrance cannot be made accessible, an accessible nonpublic entrance that is unlocked while the building is occupied shall be provided; or
2. If a main entrance cannot be made accessible, a locked accessible entrance with a notification system or remote monitoring shall be provided.

Signs complying with Section 9.10 of the SBC 201 shall be provided at the primary entrance and the accessible entrance.

**9.9.8.4 Toilet and bathing facilities.** Where toilet rooms are provided, at least one accessible toilet room complying with Section 9.9.2.1 of the SBC 201 shall be provided.

**9.9.8.5 Ramps.** The slope of a ramp run of 0.61 m maximum shall not be steeper than one unit vertical in eight units horizontal (12 percent slope).

## SECTION 9.10 COMPLIANCE ALTERNATIVES

**9.10.1 Compliance.** The provisions of this section are intended to maintain or increase the current degree of public safety, health and general welfare in existing buildings while permitting repair, alteration, addition and change of occupancy without requiring full compliance with Sections 9.1.3, and 9.3 through 9.7, except where compliance with other provisions of SBC requirements is specifically required in this section.

**9.10.2 Applicability.** Structures existing prior to THE DATE OF SBC ISSUANCE, in which there is work involving additions, alterations or changes of occupancy shall be made to conform to the requirements of this section or the provisions of Sections 9.3 through 9.7. The provisions in Sections 9.10.2.1 through 9.10.2.5 shall apply to existing occupancies that will continue to be, or are proposed to be, in Groups A, B, E, F, M, R, S and U. These provisions shall not apply to buildings with occupancies in Group H or I.

**9.10.2.1 Change in occupancy.** Where an existing building is changed to a new occupancy classification and this section is applicable, the provisions of this section for the new occupancy shall be used to determine compliance with SBC 201.

**9.10.2.2 Partial change in occupancy.** Where a portion of the building is changed to a new occupancy classification, and that portion is separated from the remainder of the building with fire barrier wall assemblies having a fire-resistance rating as required by Table 2A.2.3.2 for the separate occupancies, or with approved compliance alternatives, the portion changed shall be made to conform to the provisions of this section.

Where a portion of the building is changed to a new occupancy classification, and that portion is not separated from the remainder of the building with fire separation assemblies having a fire-resistance rating as required by Table 3A.2.3.2 for the separate occupancies, or with approved compliance alternatives, the provisions of this section which apply to each occupancy shall apply to the entire building. Where there are conflicting provisions, those requirements which secure the greater public safety shall apply to the entire building or structure.

**9.10.2.3 Additions.** Additions to existing buildings shall comply with the requirements of SBC 100 for new construction. The combined height and area of the existing building and the new addition shall not exceed the height and area allowed by Chapter 3. Where a fire wall that complies with Section 4B.5 is provided between the addition and the existing building, the addition shall be considered a separate

building.

- 9.10.2.4 Alterations and repairs.** An existing building or portion thereof, which does not comply with the requirements of SBC for new construction, shall not be altered or repaired in such a manner that results in the building being less safe or sanitary than such building is currently. If, in the alteration or repair, the current level of safety or sanitation is to be reduced, the portion altered or repaired shall conform to the requirements of SBC.
- 9.10.2.5 Accessibility requirements.** All portions of the buildings proposed for change of occupancy shall conform to the accessibility provisions of Chapter 9 of the SBC 201.
- 9.10.3 Acceptance.** For repairs, alterations, additions and changes of occupancy to existing buildings that are evaluated in accordance with this section, compliance with this section shall be accepted by the building official.
- 9.10.3.1 Hazards.** Where the building official determines that an unsafe condition exists, as provided for in SBC 100, such unsafe condition shall be abated in accordance with SBC 100.
- 9.10.3.2 Compliance with other codes.** Buildings that are evaluated in accordance with this section shall comply with these code requirements and SBC 201.
- 9.10.4 Investigation and evaluation.** For proposed work covered by this section, the building owner shall cause the existing building to be investigated and evaluated in accordance with the provisions of this section.
- 9.10.4.1 Structural analysis.** The owner shall have a structural analysis of the existing building made to determine adequacy of structural systems for the proposed alteration, addition or change of occupancy. The existing building shall be capable of supporting the minimum load requirements of SBC 301.
- 9.10.4.2 Submittal.** The results of the investigation and evaluation as required in Section 9.10.4, along with proposed compliance alternatives, shall be submitted to the building official.
- 9.10.4.3 Determination of compliance.** The local building official shall determine whether the existing building, with the proposed addition, alteration or change of occupancy, complies with the provisions of this section in accordance with the evaluation process in Sections 9.10.5 through 9.10.9.
- 9.10.5 Evaluation.** The evaluation shall be comprised of three categories: fire safety, means of egress and general safety, as defined in Sections 9.10.5.1 through 9.10.5.3.
- 9.10.5.1 Fire safety.** Included within the fire safety category are the structural fire resistance, automatic fire detection, fire alarm and fire suppression system features of the facility.
- 9.10.5.2 Means of egress.** Included within the means of egress category are the configuration, characteristics and support features for means of egress in the facility.
- 9.10.5.3 General safety.** Included within the general safety category are the fire safety parameters and the means of egress parameters.
- 9.10.6 Evaluation process.** The evaluation process specified herein shall be followed in its entirety to evaluate existing buildings. Table 9.10.7 shall be utilized for tabulating the results of the evaluation. References to other sections of SBC indicate that compliance with those sections is required in order to gain credit in



the evaluation herein outlined. In applying this section to a building with mixed occupancies, where the separation between the mixed occupancies does not qualify for any category indicated in Section 9.10.6.16, the score for each occupancy shall be determined and the lower score determined for each section of the evaluation process shall apply to the entire building.

Where the separation between the mixed occupancies qualifies for any category indicated in Section 9.10.6.16, the score for each occupancy shall apply to each portion of the building based on the occupancy of the space.

- 9.10.6.1 Building height.** The value for building height shall be the lesser value determined by the formula in Section 9.10.6.1.1. Chapter 3 shall be used to determine the allowable height of the building, including allowable increases due to automatic sprinklers as provided for in Section 3.4.2. Subtract the actual building height from the allowable and divide by 3.8 m. Enter the height value and its sign (positive or negative) in Table 9.10.7 under Safety Parameter 9.10.6.1, Building Height, for fire safety, means of egress and general safety. The maximum score for a building shall be 10.

- 9.10.6.1.1 Height formula.** The following formulas shall be used in computing the building height value.

$$\text{Height value, meters} = \frac{(AH) - (EBH)}{0.0244} \times CF \quad (\text{Equation 9-1})$$

$$\text{Height value, stories} = (AS - EBS) \times CF$$

where:

*AH* = Allowable height in meters from Table 3.3.

*EBH* = Existing building height in meters.

*AS* = Allowable height in stories from Table 3.3.

*EBS* = Existing building height in stories.

*CF* = 1 if  $(AH) - (EBH)$  is positive.

*CF* = Construction-type factor shown in Table 9.9.6.6(2) if  $(AH) - (EBH)$  is negative.

**Note.** Where mixed occupancies are separated and individually evaluated as indicated in Section 9.10.6, the values *AH*, *AS*, *EBH* and *EBS* shall be based on the height of the fire area of the occupancy being evaluated.

- 9.10.6.2 Building area.** The value for building area shall be determined by the formula in Section 9.10.6.2.2. Section 3.3 and the formula in Section 9.10.6.2.1 shall be used to determine the allowable area of the building. This shall include any allowable increases due to open perimeter and automatic sprinklers as provided for in Section 3.6. Subtract the actual building area from the allowable area and divide by 112 m<sup>2</sup>. Enter the area value and its sign (positive or negative) in Table 9.10.7 under Safety Parameter 9.10.6.2, Building Area, for fire safety, means of egress and general safety. In determining the area value, the maximum permitted positive value for area is 50 percent of the fire safety score as listed in Table 9.10.8, Mandatory Safety Scores.

- 9.10.6.2.1 Allowable area formula.** The following formula shall be used in computing allowable area:

$$AA = \frac{(SP + OP + 100) \times (\text{area, TABLE 3.3})}{100} \quad (\text{Equation 9-2})$$

where:

*AA* = Allowable area.

*SP* = Percent increase for sprinklers (Section 3.6.3).

$OP$  = Percent increase for open perimeter (Section 3.6.2).

- 9.10.6.2.2 Area formula.** The following formula shall be used in computing the area value. Determine the area value for each occupancy fire area on a floor-by-floor basis. For each occupancy, choose the minimum area value of the set of values obtained for the particular occupancy.

$$\text{Area value } i = \frac{\text{Allowable area}_i}{1,200 \text{ square feet}} \left[ 1 - \left( \frac{\text{Actual area}_i}{\text{Allowable area}_i} + \dots + \frac{\text{Actual area}_n}{\text{Allowable area}_n} \right) \right] \quad (\text{Equation 9-3})$$

where:

$i$  = Value for an individual separated occupancy on a floor.

$n$  = Number of separated occupancies on a floor.

- 9.10.6.3 Compartmentation.** Evaluate the compartments created by fire barrier walls which comply with Sections 9.10.6.3.1 and 9.10.6.3.2 and which are exclusive of the wall elements considered under Sections 9.10.6.4 and 9.10.6.5. Conforming compartments shall be figured as the net area and do not include shafts, chases, stairways, walls or columns. Using Table 9.9.6.3, determine the appropriate compartmentation value (CV) and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.3, compartmentation, for fire safety, means of egress and general safety.

**TABLE 9.9.6.3  
COMPARTMENTATION VALUES**

OCCUPANCY	CATEGORIES <sup>a</sup>				
	a Compartment size equal to or greater than 1,394 m <sup>2</sup>	b Compartment size of 929 m <sup>2</sup>	c Compartment size of 697 m <sup>2</sup>	d Compartment size of 465 m <sup>2</sup>	e Compartment size of 232 m <sup>2</sup>
A-1, A-3	0	6	10	14	18
A-2	0	4	10	14	18
A-4, B, E, S-2	0	5	10	15	20
F, M, R, S-1	0	4	10	16	22

a. For areas between categories, the compartmentation value shall be obtained by linear interpolation.

- 9.10.6.3.1 Wall construction.** A wall used to create separate compartments shall be a fire barrier conforming to Section 4B.6 with a fire-resistance rating of not less than 2 hours. Where the building is not divided into more than one compartment, the compartment size shall be taken as the total floor area on all floors. Where there is more than one compartment within a story, each compartmented area on such story shall be provided with a horizontal exit conforming to Section 8.21. The fire door serving as the horizontal exit between compartments shall be so installed, fitted and gasketed that such fire door will provide a substantial barrier to the passage of smoke.
- 9.10.6.3.2 Floor/ceiling construction.** A floor/ceiling assembly used to create compartments shall conform to Section 4B.11 and shall have a fire-resistance rating of not less than 2 hours.
- 9.10.6.4 Tenant and dwelling unit separations.** Evaluate the fire-resistance rating of floors and walls separating tenants, including dwelling units, and not evaluated under Sections 9.10.6.3 and 9.10.6.5. Under the categories and occupancies in Table 9.10.6.4, determine the appropriate value and enter that value in Table 9.10.7 under Safety Parameter 9.10.6.4, Tenant and Dwelling Unit Separation, for

fire safety, means of egress and general safety.

**TABLE 9.10.6.4  
SEPARATION VALUES**

OCCUPANCY	CATEGORIES				
	a	b	c	d	e
A-1	0	0	0	0	1
A-2	-5	-3	0	1	3
R	-4	-2	0	2	4
A-3, A-4, B, E, F, M, S-1	-4	-3	0	2	4
S-2	-5	-2	0	2	4

**9.10.6.4.1 Categories.** The categories for tenant and dwelling unit separations are:

1. Category a – No fire partitions; incomplete fire partitions; no doors; doors not self-closing or automatic closing.
2. Category b – Fire partitions or floor assembly less than 1-hour fire-resistance rating or not constructed in accordance with Sections 4B.8 or 4B.11, respectively.
3. Category c – Fire partitions with 1 hour or greater fire-resistance rating constructed in accordance with Section 4B.8 and floor assemblies with 1-hour but less than 2-hour fire-resistance rating constructed in accordance with Section 4B.11, or with only one tenant within the fire area.
4. Category d – Fire barriers with 1-hour but less than 2-hour fire-resistance rating constructed in accordance with Section 4B.6 and floor assemblies with 2-hour or greater fire-resistance rating constructed in accordance with Section 4B.11.
5. Category e – Fire barriers and floor assemblies with 2-hour or greater fire-resistance rating and constructed in accordance with Sections 4B.6 and 4B.11, respectively.

**9.10.6.5 Corridor walls.** Evaluate the fire-resistance rating and degree of completeness of walls which create corridors serving the floor, and constructed in accordance with Section 8.16. This evaluation shall not include the wall elements considered under Sections 9.10.6.3 and 9.10.6.4. Under the categories and groups in Table 9.10.6.5, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.5, Corridor Walls, for fire safety, means of egress and general safety.

**TABLE 9.10.6.5  
CORRIDOR WALL VALUES**

OCCUPANCY	CATEGORIES			
	a	b	c <sup>a</sup>	d <sup>a</sup>
A-1	-10	-4	0	2
A-2	-30	-12	0	2
A-3, F, M, R, S-1	-7	-3	0	2
A-4, B, E, S-2	-5	-2	0	5

a. Corridors not providing at least one-half the travel distance for all occupants on a floor shall use Category b.

**9.10.6.5.1 Categories.** The categories for corridor walls are:

1. Category a – No fire partitions; incomplete fire partitions; no doors; or doors not self-closing.
2. Category b – Less than 1-hour fire-resistance rating or not constructed in accordance with Section 4B.8.4.
3. Category c – 1-hour to less than 2-hour fire-resistance rating, with doors conforming to Section 4B.15 or without corridors as permitted by Section 8.16.
4. Category d – 2-hour or greater fire-resistance rating, with doors conforming to Section 4B.15.

**9.10.6.6 Vertical openings.** Evaluate the fire-resistance rating of vertical exit enclosures, hoistways, escalator openings and other shaft enclosures within the building, and openings between two or more floors. Table 9.10.6.6(1) contains the appropriate protection values. Multiply that value by the construction-type factor found in Table 9.10.6.6(2). Enter the vertical opening value and its sign (positive or negative) in Table 9.10.7 under Safety Parameter 9.10.6.6, Vertical Openings, for fire safety, means of egress and general safety. If the structure is a one-story building, enter a value of 2. Unenclosed vertical openings that conform to the requirements of Section 4.8 shall not be considered in the evaluation of vertical openings.

**9.10.6.6.1 Vertical opening formula.** The following formula shall be used in computing vertical opening value.

$$VO = PV \times CF \quad \text{(Equation 9-4)}$$

where:

$VO$  = Vertical opening value.

$PV$  = Protection value [Table 9.9.6.6(1)].

$CF$  = Construction type factor [Table 9.9.6.6(2)].

**TABLE 9.10.6.6(1)**  
**VERTICAL OPENING PROTECTION VALUE**

PROTECTION	VALUE
None (unprotected opening)	-2 times number floors connected
Less than 1 hour	-1 times number floors connected
1 to less than 2 hours	1
2 hours or more	2

**TABLE 9.10.6.6(2)**  
**CONSTRUCTION-TYPE FACTOR**

FACTOR	TYPE OF CONSTRUCTION								
	IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
	1.2	1.5	2.2	3.5	2.5	3.5	2.3	3.3	7

**9.10.6.7 HVAC systems.** Evaluate the ability of the HVAC system to resist the movement of smoke and fire beyond the point of origin. Under the categories in Section 9.9.6.7.1, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.7, HVAC Systems, for fire safety, means of egress and general safety.

**9.10.6.7.1 Categories.** The categories for HVAC systems are:

1. Category a – Plenums not in accordance with Section 4.2 of the SBC 201. -10 points.
2. Category b – Air movement in egress elements not in accordance with Section 8.16.4. -5 points.
3. Category c – Both categories a and b are applicable. -15 points.
4. Category d – Compliance of the HVAC system with Section 8.16.4 and SBC 501. 0 points.
5. Category e – Systems serving one story; or a central boiler/chiller system without ductwork connecting two or more stories. 5 points.

**9.10.6.8 Automatic fire detection.** Evaluate the smoke detection capability based on the location and operation of automatic fire detectors in accordance with SBC 501. Under the categories and occupancies in Table 9.10.6.8, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.8, Automatic Fire Detection, for fire safety, means of egress and general safety.

**TABLE 9.10.6.8  
AUTOMATIC FIRE DETECTION VALUES**

OCCUPANCY	CATEGORIES				
	a	b	c	d	e
A-1, A-3, F, M, R, S-1	-10	-5	0	2	6
A-2	-25	-5	0	5	9
A-4, B, E, S-2	-4	-2	0	4	8

**9.10.6.8.1 Categories.** The categories for automatic fire detection are:

1. Category a – None.
2. Category b – Existing smoke detectors in HVAC systems and maintained in accordance with these code requirements.
3. Category c – Smoke detectors in HVAC systems. The detectors are installed in accordance with the requirements for new buildings in the SBC 501.
4. Category d – Smoke detectors throughout all floor areas other than individual guestrooms, tenant spaces and dwelling units.
5. Category e – Smoke detectors installed throughout the fire area.

**9.10.6.9 Fire alarm systems.** Evaluate the capability of the fire alarm system in accordance with Section 7.7. Under the categories and occupancies in Table 9.10.6.9, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.9, Fire Alarm, for fire safety, means of egress and general safety.

**TABLE 9.10.6.9  
FIRE ALARM SYSTEM VALUES**

OCCUPANCY	CATEGORIES			
	a	b <sup>a</sup>	c	d
A-1, A-2, A-3, A-4, B, E, R	-10	-5	0	5
F, M, S	0	5	10	15

- a. For buildings equipped throughout with an automatic sprinkler system, add 2 points for activation by a sprinkler water flow device.

**9.10.6.9.1 Categories.** The categories for fire alarm systems are:

1. Category a – None.
2. Category b – Fire alarm system with manual fire alarm boxes in accordance with Section 7.7.3 and alarm notification appliances in accordance with Section 7.7.9.
3. Category c – Fire alarm system in accordance with Section 7.7.
4. Category d – Category c plus a required emergency voice/alarm communications system and a fire command station that conforms to Section 2B.3.8 and contains the emergency voice/alarm communications system controls, Civil Defence communication system controls and any other controls specified in Section 7.11 where those systems are provided.

**9.10.6.10 Smoke control.** Evaluate the ability of a natural or mechanical venting, exhaust or pressurization system to control the movement of smoke from a fire. Under the categories and occupancies in Table 9.10.6.10, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.10, Smoke Control, for means of egress and general safety.

**TABLE 9.10.6.10**  
**SMOKE CONTROL VALUES**

OCCUPANCY	CATEGORIES					
	a	b	c	d	e	f
A-1, A-2, A-3	0	1	2	3	6	6
A-4, E	0	0	0	1	3	5
B, M, R	0	2 <sup>a</sup>	3 <sup>a</sup>	3 <sup>a</sup>	3a	4 <sup>a</sup>
F, S	0	2 <sup>a</sup>	2 <sup>a</sup>	3 <sup>a</sup>	3a	3 <sup>a</sup>

- a. This value shall be 0 if compliance with Category d or e in Section 9.10.6.8.1 has not been obtained.

**9.10.6.10.1 Categories.** The categories for smoke control are:

1. Category a – None.
2. Category b – The building is equipped throughout with an automatic sprinkler system. Openings are provided in exterior walls at the rate of 1.86 m<sup>2</sup> per 15.3 linear meters of exterior wall in each story and distributed around the building perimeter at intervals not exceeding 15.3 meters. Such openings shall be readily openable from the inside without a key or separate tool and shall be provided with ready access thereto. In lieu of operable openings, clearly and permanently marked tempered glass panels shall be used.
3. Category c – One enclosed exit stairway, with ready access thereto, from each occupied floor of the building. The stairway has operable exterior windows and the building has openings in accordance with Category b.
4. Category d – One smokeproof enclosure and the building has openings in accordance with Category b.
5. Category e – The building is equipped throughout with an automatic sprinkler system. Each fire area is provided with a mechanical air-handling system designed to accomplish smoke containment. Return and exhaust air shall be moved directly to the outside without recirculation to other fire areas of the building under fire conditions. The system shall exhaust not less than six air changes per hour from the fire area. Supply air by mechanical means to the fire area is not required. Containment of smoke shall be considered as



confining smoke to the fire area involved without migration to other fire areas. Any other tested and approved design which will adequately accomplish smoke containment is permitted.

6. Category f – Each stairway shall be one of the following: a smokeproof enclosure in accordance with Section 8.19.1.8; pressurized in accordance with Section 7.9.20.5; or shall have operable exterior windows.

**9.10.6.11 Means of egress capacity and number.** Evaluate the means of egress capacity and the number of exits available to the building occupants. In applying this section, the means of egress are required to conform to Sections 8.3 through 8.14 and 8.16 through 8.23 (except that the minimum width required by this section shall be determined solely by the width for the required capacity in accordance with Table 8.5.1). The number of exits credited is the number that are available to each occupant of the area being evaluated. Existing fire escapes shall be accepted as a component in the means of egress when conforming to Section 9.4. Under the categories and occupancies in Table 9.10.6.11, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.11, Means of Egress Capacity, for means of egress and general safety.

**TABLE 9.10.6.11  
MEANS OF EGRESS VALUES**

OCCUPANCY	CATEGORIES				
	a <sup>a</sup>	b	c	d	e
A-1, A-2, A-3, A-4, E	-10	0	2	8	10
M	-3	0	1	2	4
B, F, S	-1	0	0	0	0
R	-3	0	0	0	0

a. The values indicated are for buildings six stories or less in height. For buildings over six stories in height, add an additional -10 points.

**9.10.6.11.1 Categories.** The categories for means of egress capacity and number of exits are:

1. Category a – Compliance with the minimum required means of egress capacity or number of exits is achieved through the use of a fire escape in accordance with Section 9.3.
2. Category b – Capacity of the means of egress complies with Section 8.4 and the number of exits complies with the minimum number required by Section 8.18.
3. Category c – Capacity of the means of egress is equal to or exceeds 125 percent of the required means of egress capacity, the means of egress complies with the minimum required width dimensions specified in the code and the number of exits complies with the minimum number required by Section 8.18.
4. Category d – The number of exits provided exceeds the number of exits required by Section 8.18. Exits shall be located a distance apart from each other equal to not less than that specified in Section 8.14.2.
5. Category e – The area being evaluated meets both Categories c and d.

**9.10.6.12 Dead ends.** In spaces required to be served by more than one means of egress, evaluate the length of the exit access travel path in which the building occupants

are confined to a single path of travel. Under the categories and occupancies in Table 9.10.6.12, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.12, Dead Ends, for means of egress and general safety.

**9.10.6.12.1 Categories.** The categories for dead ends are:

1. Category a – Dead end of 10.7 m in nonsprinklered buildings or 21.3 m in sprinklered buildings.
2. Category b – Dead end of 6.1 m; or 15.3 m in Group B in accordance with Section 8.16.3, Exception 2.
3. Category c – No dead ends; or ratio of length to width (l/w) is less than 2.5:1.

**TABLE 9.10.6.12  
DEAD-END VALUES<sup>a</sup>**

OCCUPANCY	CATEGORIES		
	a	b	c
A-1, A-3, A-4, B, E, F, M, R, S	-2	0	2
A-2, E	-2	0	2

- a. For dead-end distances between categories, the dead-end value shall be obtained by linear interpolation.

**9.10.6.13 Maximum exit access travel distance.** Evaluate the length of exit access travel to an approved exit. Determine the appropriate points in accordance with the following equation and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.13, Maximum Exit Access Travel Distance, for means of egress and general safety. The maximum allowable exit access travel distance shall be determined in accordance with Section 8.15.1.

$$\text{Points} = 20 \times \frac{\text{Maximum allowable travel distance} - \text{Maximum actual travel distance}}{\text{Max. allowable travel distance}}$$

**9.10.6.14 Elevator control.** Evaluate the passenger elevator equipment and controls that are available to the Civil Defence to reach all occupied floors. Elevator recall controls shall be provided in accordance with these code requirements. Under the categories and occupancies in Table 9.10.6.14, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.14, Elevator Control, for fire safety, means of egress and general safety. The values shall be zero for a single-story building.

**TABLE 9.10.6.14  
ELEVATOR CONTROL VALUES**

ELEVATOR TRAVEL	CATEGORIES			
	a	b	c	d
Less than 7.6 meters of travel above or below the primary level of elevator access for emergency fire-fighting or rescue personnel	-2	0	0	+2
Travel of 7.6 meters or more above or below the primary level of elevator access for emergency fire-fighting or rescue personnel	-4	NP	0	+4



**9.10.6.14.1 Categories.** The categories for elevator controls are:

1. Category a – No elevator.
2. Category b – Any elevator without Phase I and II recall.
3. Category c – All elevators with Phase I and II recall as required by these code requirements.
4. Category d – All meet Category c; or Category b where permitted to be without recall; and at least one elevator that complies with new construction requirements serves all occupied floors.

**9.10.6.15 Means of egress emergency lighting.** Evaluate the presence of and reliability of means of egress emergency lighting. Under the categories and occupancies in Table 9.10.6.15, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.15, Means of Egress Emergency Lighting, for means of egress and general safety.

**TABLE 9.10.6.15  
MEANS OF EGRESS EMERGENCY LIGHTING VALUES**

NUMBER OF EXITS REQUIRED BY SECTION 8.10	CATEGORIES		
	a	b	c
Two or more exits	NP	0	4
Minimum of one exit	0	1	1

**9.10.6.15.1 Categories.** The categories for means of egress emergency lighting are:

1. Category a – Means of egress lighting and exit signs not provided with emergency power in accordance with SBC 401.
2. Category b – Means of egress lighting and exit signs provided with emergency power in accordance with SBC 401.
3. Category c – Emergency power provided to means of egress lighting and exit signs which provides protection in the event of power failure to the site or building.

**9.10.6.16 Mixed occupancies.** Where a building has two or more occupancies that are not in the same occupancy classification, the separation between the mixed occupancies shall be evaluated in accordance with this section. Where there is no separation between the mixed occupancies or the separation between mixed occupancies does not qualify for any of the categories indicated in Section 9.10.6.16.1, the building shall be evaluated as indicated in Section 9.10.6 and the value for mixed occupancies shall be zero. Under the categories and occupancies in Table 9.10.6.16, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.16, Mixed Occupancies, for fire safety and general safety. For buildings without mixed occupancies, the value shall be zero.

**TABLE 9.10.6.16  
MIXED OCCUPANCY VALUES<sup>a</sup>**

OCCUPANCY	CATEGORIES		
	a	b	c
A-1, A-2, R	-10	0	10
A-3, A-4, B, E, F, M, S	-5	0	5

a. For fire-resistance ratings between categories, the value shall be obtained by linear interpolation.

**9.10.6.16.1 Categories.** The categories for mixed occupancies are:

1. Category a – Minimum 1-hour fire barriers between occupancies.
2. Category b – Fire barriers between occupancies in accordance with Section 2A.2.3.2.
3. Category c – Fire barriers between occupancies having a fire-resistance rating of not less than twice that required by Section 2A.2.3.2.

**9.10.6.17 Automatic sprinklers.** Evaluate the ability to suppress a fire based on the installation of an automatic sprinkler system in accordance with Section 7.3.3.1.1. “Required sprinklers” shall be based on the requirements of *Saudi Building Code*. Under the categories and occupancies in Table 9.10.6.17, determine the appropriate value and enter that value into Table 9.10.7 under Safety Parameter 9.10.6.17, Automatic Sprinklers, for fire safety, means of egress divided by 2 and general safety.

**TABLE 9.10.6.17  
SPRINKLER SYSTEM VALUES**

OCCUPANCY	CATEGORIES					
	a	b	c	d	e	f
A-1, A-3, F, M, R, S-1	-6	-3	0	2	4	6
A-2	-4	-2	0	1	2	4
A-4, B, E, S-2	-12	-6	0	3	6	12

**9.10.6.17.1 Categories.** The categories for automatic sprinkler system protection are:

1. Category a – Sprinklers are required throughout; sprinkler protection is not provided or the sprinkler system design is not adequate for the hazard protected in accordance with Section 7.3.
2. Category b – Sprinklers are required in a portion of the building; sprinkler protection is not provided or the sprinkler system design is not adequate for the hazard protected in accordance with Section 7.3.
3. Category c – Sprinklers are not required; none are provided.
4. Category d – Sprinklers are required in a portion of the building; sprinklers are provided in such portion; the system is one which complied with the code at the time of installation and is maintained and supervised in accordance with Section 7.3.
5. Category e – Sprinklers are required throughout; sprinklers are provided throughout in accordance with Chapter 7.
6. Category f – Sprinklers are not required throughout; sprinklers are provided throughout in accordance with Chapter 7.

**9.10.6.18 Incidental use.** Evaluate the protection of incidental use areas in accordance with Section 2A.2.1.1. Do not include those where *Saudi Building Code* requires suppression throughout the building including covered mall buildings, high-rise buildings, public garages and unlimited area buildings. Assign the lowest score from Table 9.9.6.18 for the building or fire area being evaluated. If there are no specific occupancy areas in the building or fire area being evaluated, the value shall be zero.

**9.10.7 Building score.** After determining the appropriate data from Section 9.10.6, enter those data in Table 9.10.7 and total the building score.

**9.10.8 Safety scores.** The values in Table 9.10.8 are the required mandatory safety scores for the evaluation process listed in Section 9.10.6.

**9.10.9 Evaluation of building safety.** The mandatory safety score in Table 9.10.8 shall be subtracted from the building score in Table 9.10.7 for each category. Where the final score for any category equals zero or more, the building is in compliance with the requirements of this section for that category. Where the final score for any category is less than zero, the building is not in compliance with the requirements of this section.

**9.10.9.1 Mixed occupancies.** For mixed occupancies, the following provisions shall apply:

1. Where the separation between mixed occupancies does not qualify for any category indicated in Section 9.10.6.16, the mandatory safety scores for the occupancy with the lowest general safety score in Table 9.10.8 shall be utilized (see Section 9.10.6).
2. Where the separation between mixed occupancies qualifies for any category indicated in Section 9.10.6.16, the mandatory safety scores for each occupancy shall be placed against the evaluation scores for the appropriate occupancy.

**TABLE 9.10.6.18  
INCIDENTAL USE AREA VALUES<sup>a</sup>**

PROTECTION REQUIRED BY TABLE 2A.2.1.1	PROTECTION PROVIDED						
	None	1 Hour	AFSS	AFSS with SP	1 Hour and AFSS	2 Hours	2 Hours and AFSS
2 Hours and AFSS	-4	-3	-2	-2	-1	-2	0
2 Hours, or 1 Hour and AFSS	-3	-2	-1	-1	0	0	0
1 Hour and AFSS	-3	-2	-1	-1	0	-1	0
1 Hour	-1	0	-1	0	0	0	0
1 Hour, or AFSS with SP	-1	0	-1	0	0	0	0
AFSS with SP	-1	-1	-1	0	0	-1	0
1 Hour or AFSS	-1	0	0	0	0	0	0

a. AFSS = Automatic fire suppression system; SP = Smoke partitions (See Section 2A.2.1.1.1).

**TABLE 9.10.7**  
**SUMMARY SHEET - BUILDING CODE**

Existing occupancy _____ Proposed occupancy _____			
Year building was constructed _____ Number of stories _____ Height in meters _____			
Type of construction _____ Area per floor _____			
Percentage of open perimeter _____ % Percentage of height reduction _____ %			
Completely suppressed: Yes _____ No _____ Corridor wall rating _____			
Compartmentation: Yes _____ No _____ Required door closers: Yes _____ No _____			
Fire-resistance rating of vertical opening enclosures _____			
Type of HVAC system _____, Serving number of floors _____			
Automatic fire detection: Yes _____ No _____, Type and location _____			
Fire alarm system: Yes _____ No _____, Type _____			
Smoke control: Yes _____ No _____, Type _____			
Adequate exit routes: Yes _____ No _____ Dead ends: _____ Yes _____ No _____			
Maximum exit access travel distance _____ Elevator controls: Yes _____ No _____			
Means of egress emergency lighting: Yes _____ No _____ Mixed occupancies: Yes _____ No _____			
SAFETY PARAMETERS	FIRE SAFETY (FS)	MEANS OF EGRESS (ME)	GENERAL SAFETY (GS)
9.10.6.1 Building Height			
9.10.6.2 Building Area			
9.10.6.3 Compartmentation			
9.10.6.4 Tenant and Dwelling Unit Separations			
9.10.6.5 Corridor Walls			
9.10.6.6 Vertical Openings			
9.10.6.7 HVAC Systems			
9.10.6.8 Automatic Fire Detection			
9.10.6.9 Fire Alarm System			
9.10.6.10 Smoke control	* * * *		
9.10.6.11 Means of Egress	* * * *		
9.10.6.12 Dead ends	* * * *		
9.10.6.13 Maximum Exit Access Travel Distance	* * * *		
9.10.6.14 Elevator Control			
9.10.6.15 Means of Egress Emergency Lighting	* * * *		
9.10.6.16 Mixed Occupancies		* * * *	
9.10.6.17 Automatic Sprinklers		÷ 2 =	
9.10.6.18 Incidental Use			
<b>Building score - total value</b>			

\* \* \* \* No applicable value to be inserted.

**TABLE 9.10.8**  
**MANDATORY SAFETY SCORES**

<b>OCCUPANCY</b>	<b>FIRE SAFETY (MFS)</b>	<b>MEANS OF EGRESS (MME)</b>	<b>GENERAL SAFETY (MGS)</b>
A-1	16	27	27
A-2	19	30	30
A-3	18	29	29
A-4, E	23	34	34
B	24	34	34
F	20	30	30
M	19	36	36
R	17	34	34
S-1	15	25	25
S-2	23	33	33

- a. MFS = Mandatory Fire Safety;  
MME = Mandatory Means of Egress;  
MGS = Mandatory General Safety.

**TABLE 9.10.9**  
**EVALUATION FORMULAS<sup>a</sup>**

<b>FORMULA</b>	<b>T.9.9.7</b>	<b>T.9.9.8</b>	<b>SCORE</b>	<b>PASS</b>	<b>FAIL</b>
FS-MFS $\geq 0$	_____ (FS)	- _____ (MFS) =	_____	_____	_____
ME-MME $\geq 0$	_____ (ME)	- _____ (MME) =	_____	_____	_____
GS-MGS $\geq 0$	_____ (GS)	- _____ (MGS) =	_____	_____	_____

- a. FS = Fire Safety; MFS = Mandatory Fire Safety;  
ME = Means of Egress; MME = Mandatory Means of Egress;  
GS = General Safety; MGS = Mandatory General Safety.

**CHAPTER 10**  
**FIRE SAFETY DURING CONSTRUCTION AND DEMOLITION**

**SECTION 10.1**  
**GENERAL**

- 10.1.1 Scope.** This chapter shall apply to structures in the course of construction, alteration, or demolition, including those in underground locations. Compliance with NFPA 241 is required for items not specifically addressed herein.
- 10.1.2 Purpose.** This chapter prescribes minimum safeguards for construction, alteration, and demolition operations to provide reasonable safety to life and property from fire during such operations.

**SECTION 10.2**  
**DEFINITIONS**

- 10.2.1 Terms defined in Chapter 1.** Words and terms used in this chapter and defined in Chapter 1 shall have the meanings ascribed to them as defined therein.

**SECTION 10.3**  
**TEMPORARY HEATING EQUIPMENT**

- 10.3.1 Listed.** Temporary heating devices shall be listed and labeled in accordance with the SBC 501. Installation, maintenance and use of temporary heating devices shall be in accordance with the terms of the listing.
- 10.3.2 Oil-fired heaters.** Oil-fired heaters shall comply with SBC 501.
- 10.3.3 LP-gas heaters.** Fuel supplies for liquefied-petroleum gas-fired heaters shall comply with Chapter 36.
- 10.3.4 Refueling.** Refueling operations shall be conducted in accordance with Section 30.5. The appliance shall be allowed to cool prior to refueling.
- 10.3.5 Installation.** Clearance to combustibles from temporary heating devices shall be maintained in accordance with the labeled equipment. When in operation, temporary heating devices shall be fixed in place and protected from damage, dislodgement or overturning in accordance with the manufacturer's instructions.
- 10.3.6 Supervision.** The use of temporary heating devices shall be supervised and maintained only by competent personnel.

**SECTION 10.4**  
**PRECAUTIONS AGAINST FIRE**

- 10.4.1 Smoking.** Smoking shall be prohibited except in approved areas. Signs shall be posted in accordance with Chapter 15 of the SBC 201. In approved areas where smoking is permitted, approved ashtrays shall be provided in accordance with Chapter 15 of the SBC 201.
- 10.4.2 Waste disposal.** Combustible debris shall not be accumulated within buildings. Combustible debris, rubbish and waste material shall be removed from buildings at

the end of each shift of work. Combustible debris, rubbish and waste material shall not be disposed of by burning on the site unless approved.

- 10.4.3 **Open burning.** Open burning shall comply with Section 5A.7.
- 10.4.4 **Spontaneous ignition.** Materials susceptible to spontaneous ignition, such as oily rags, shall be stored in a listed disposal container.
- 10.4.5 **Fire watch.** When required by the Building code official for building demolition that is hazardous in nature, qualified personnel shall be provided to serve as an on-site fire watch. Fire watch personnel shall be provided with at least one approved means for notification of the Civil Defence and their sole duty shall be to perform constant patrols and watch for the occurrence of fire.
- 10.4.6 **Cutting and welding.** Operations involving the use of cutting and welding shall be done in accordance with Chapter 24.
- 10.4.7 **Electrical.** Temporary wiring for electrical power and lighting installations used in connection with the construction, alteration or demolition of buildings, structures, equipment or similar activities shall comply with the SBC 401.

## SECTION 10.5 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- 10.5.1 **Storage of flammable and combustible liquids.** Storage of flammable and combustible liquids shall be in accordance with Section 30.4.
- 10.5.2 **Class I and Class II liquids.** The storage, use and handling of flammable and combustible liquids at construction sites shall be in accordance with Section 30.6.2. Ventilation shall be provided for operations involving the application of materials containing flammable solvents.
- 10.5.3 **Housekeeping.** Flammable and combustible liquid storage areas shall be maintained clear of combustible vegetation and waste materials. Such storage areas shall not be used for the storage of combustible materials.
- 10.5.4 **Precautions against fire.** Sources of ignition and smoking shall be prohibited in flammable and combustible liquid storage areas. Signs shall be posted in accordance with Chapter 15 of the SBC 201.
- 10.5.5 **Handling at point of final use.** Class I and II liquids shall be kept in approved safety containers.
- 10.5.6 **Leakage and spills.** Leaking vessels shall be immediately repaired or taken out of service and spills shall be cleaned up and disposed of properly.

## SECTION 10.6 FLAMMABLE GASES

- 10.6.1 **Storage and handling.** The storage, use and handling of flammable gases shall comply with Chapter 33.

## **SECTION 10.7 EXPLOSIVE MATERIALS**

- 10.7.1 Storage and handling.** Explosive materials shall be stored, used and handled in accordance with Chapter 31.
- 10.7.2 Supervision.** Blasting operations shall be conducted in accordance with Chapter 31.
- 10.7.3 Demolition using explosives.** Approved fire hoses for use by demolition personnel shall be maintained at the demolition site whenever explosives are used for demolition. Such fire hoses shall be connected to an approved water supply and shall be capable of being brought to bear on post-detonation fires anywhere on the site of the demolition operation.

## **SECTION 10.8 OWNER'S RESPONSIBILITY FOR FIRE PROTECTION**

- 10.8.1 Program superintendent.** The owner shall designate a person to be the Fire Prevention Program Superintendent who shall be responsible for the fire prevention program and ensure that it is carried out through completion of the project. The fire prevention program superintendent shall have the authority to enforce the provisions of this chapter and other provisions as necessary to secure the intent of this chapter. Where guard service is provided, the superintendent shall be responsible for the guard service.
- 10.8.2 Prefire plans.** The fire prevention program superintendent shall develop and maintain an approved prefire plan in cooperation with the Building code official. The Building code official shall be notified of changes affecting the utilization of information contained in such prefire plans.
- 10.8.3 Training.** Training of responsible personnel in the use of fire protection equipment shall be the responsibility of the fire prevention program superintendent.
- 10.8.4 Fire protection devices.** The fire prevention program superintendent shall determine that all fire protection equipment is maintained and serviced in accordance with these code requirements. The quantity and type of fire protection equipment shall be approved.
- 10.8.5 Hot work operations.** The superintendent shall be responsible for supervising the permit system for hot work operations in accordance with Chapter 24.
- 10.8.6 Impairment of fire protection systems.** Impairments to any fire protection system shall be in accordance with Section 7.1.
- 10.8.7 Temporary covering of fire protection devices.** Coverings placed on or over fire protection devices to protect them from damage during construction processes shall be immediately removed upon the completion of the construction processes in the room or area in which the devices are installed.



## **SECTION 10.9 FIRE ALARM REPORTING**

- 10.9.1 Emergency telephone.** Readily accessible emergency telephone facilities shall be provided in an approved location at the construction site. The street address of the construction site and the emergency telephone number of the Civil Defence shall be posted adjacent to the telephone.

## **SECTION 10.10 ACCESS FOR FIRE FIGHTING**

- 10.10.1 Required access.** Approved vehicle access for fire fighting shall be provided to all construction or demolition sites. Vehicle access shall be provided to within 30.5 m of temporary or permanent Civil Defence connections. Vehicle access shall be provided by either temporary or permanent roads, capable of supporting vehicle loading under all weather conditions. Vehicle access shall be maintained until permanent fire apparatus access roads are available.
- 10.10.2 Key boxes.** Key boxes shall be provided as required by Chapter 5.

## **SECTION 10.11 MEANS OF EGRESS**

- 10.11.1 Stairways required.** Where a building has been constructed to a height greater than 15.2 m or four stories, or where an existing building exceeding 15.2 m in height is altered, at least one temporary lighted stairway shall be provided unless one or more of the permanent stairways are erected as the construction progresses.
- 10.11.2 Maintenance.** Required means of egress shall be maintained during construction and demolition, remodeling or alterations and additions to any building.  
**Exception:** Approved temporary means of egress systems and facilities.

## **SECTION 10.12 WATER SUPPLY FOR FIRE PROTECTION**

- 10.12.1 When required.** An approved water supply for fire protection, either temporary or permanent, shall be made available as soon as combustible material arrives on the site.

## **SECTION 10.13 STANDPIPES**

- 10.13.1 Where required.** Buildings four or more stories in height shall be provided with not less than one standpipe for use during construction. Such standpipes shall be installed when the progress of construction is not more than 12.2 m in height above the lowest level of Civil Defence access. Such standpipe shall be provided with Civil Defence hose connections at accessible locations adjacent to usable stairs. Such standpipes shall be extended as construction progresses to within one floor of the highest point of construction having secured decking or flooring.
- 10.13.2 Buildings being demolished.** Where a building is being demolished and a standpipe is existing within such a building, such standpipe shall be maintained in

an operable condition so as to be available for use by the Civil Defence. Such standpipe shall be demolished with the building but shall not be demolished more than one floor below the floor being demolished.

**10.13.3 Detailed requirements.** Standpipes shall be installed in accordance with the provisions of Section 7.5.

**Exception:** Standpipes shall be either temporary or permanent in nature, and with or without a water supply, provided that such standpipes comply with the requirements of Section 7.5 as to capacity, outlets and materials.

## **SECTION 10.14 AUTOMATIC SPRINKLER SYSTEM**

**10.14.1 Completion before occupancy.** In buildings where an automatic sprinkler system is required by these code requirements, it shall be unlawful to occupy any portion of a building or structure until the automatic sprinkler system installation has been tested and approved, except as provided in SBC 100.

**10.14.2 Operation of valves.** Operation of sprinkler control valves shall be allowed only by properly authorized personnel and shall be accompanied by notification of duly designated parties. When the sprinkler protection is being regularly turned off and on to facilitate connection of newly completed segments, the sprinkler control valves shall be checked at the end of each work period to ascertain that protection is in service.

## **SECTION 10.15 PORTABLE FIRE EXTINGUISHERS**

**10.15.1 Where required.** Structures under construction, alteration or demolition shall be provided with not less than one approved portable fire extinguisher in accordance with Section 7.6 and sized for not less than ordinary hazard as follows:

1. At each stairway on all floor levels where combustible materials have accumulated.
2. In every storage and construction shed.
3. Additional portable fire extinguishers shall be provided where special hazards exist including, but not limited to, the storage and use of flammable and combustible liquids.

## **SECTION 10.16 MOTORIZED EQUIPMENT**

**10.16.1 Conditions of use.** Internal-combustion-powered construction equipment shall be used in accordance with all of the following conditions:

1. Equipment shall be located so that exhausts do not discharge against combustible material.
2. Exhausts shall be piped to the outside of the building.
3. Equipment shall not be refueled while in operation.
4. Fuel for equipment shall be stored in an approved area outside of the building.

**SECTION 10.17**  
**SAFEGUARDING ROOFING OPERATIONS**

- 10.17.1 General.** Roofing operations utilizing heat-producing systems or other ignition sources shall be performed by a contractor licensed and bonded for the type of roofing process to be performed.
- 10.17.2 Asphalt and tar kettles.** Asphalt and tar kettles shall be operated in accordance with Section 5A.3.
- 10.17.3 Fire extinguishers for roofing operations.** Fire extinguishers shall be installed in accordance with Section 7.6. There shall be not less than one multi-purpose portable fire extinguisher with a minimum 3-A 40-B:C rating on the roof being covered or repaired.  
**Exception:** Approved temporary means of egress systems and facilities.

## CHAPTER 11 AVIATION FACILITIES

### SECTION 11.1 GENERAL

- 11.1.1 **Scope.** Airports, heliports, helistops and aircraft hangars shall be in accordance with this chapter.
- 11.1.2 **Regulations not covered.** Regulations not specifically contained herein pertaining to airports, aircraft maintenance, aircraft hangars and appurtenant operations shall be in accordance with nationally recognized standards.
- 11.1.3 **Permits.** For permits to operate aircraft-refueling vehicles, application of flammable or combustible finishes, and hot work, see SBC 100.

### SECTION 11.2 DEFINITIONS

- 11.2.1 **Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**AIRCRAFT OPERATION AREA (AOA).** Any area used or intended for use for the parking, taxiing, takeoff, landing or other ground-based aircraft activity.

**AIRPORT.** An area of land or structural surface that is used, or intended for use, for the landing and taking off of aircraft with an overall length greater than 11.9 m and an overall exterior fuselage width greater than 2 m, and any appurtenant areas that are used or intended for use for airport buildings and other airport facilities.

**HELIPORT.** An area of land or water or a structural surface that is used, or intended for use, for the landing and taking off of helicopters, and any appurtenant areas which are used, or intended for use, for heliport buildings and other heliport facilities.

**HELISTOP.** The same as “Heliport,” except that no fueling, defueling, maintenance, repairs or storage of helicopters is permitted.

### SECTION 11.3 GENERAL PRECAUTIONS

- 11.3.1 **Sources of ignition.** Open flames, flame-producing devices and other sources of ignition shall not be permitted in a hangar, except in approved locations or in any location within 15.2 m of an aircraft-fueling operation.
- 11.3.2 **Smoking.** Smoking shall be prohibited in aircraft-refueling vehicles, aircraft hangars and aircraft operation areas used for cleaning, paint removal, painting operations or fueling. “No Smoking” signs shall be provided in accordance with Section 5A.10.  
**Exception:** Designated and approved smoking areas.

- 11.3.3 Housekeeping.** The aircraft operation area (AOA) and related areas shall be kept free from combustible debris at all times.
- 11.3.4 Civil Defence access.** Fire apparatus access roads shall be provided and maintained in accordance with Chapter 5. Fire apparatus access roads and aircraft parking positions shall be designed in a manner so as to preclude the possibility of fire vehicles traveling under any portion of a parked aircraft.
- 11.3.5 Dispensing of flammable and combustible liquids.** The dispensing, transferring and storage of flammable and combustible liquids shall be in accordance with this chapter and Chapter 32. Aircraft motor vehicle fuel-dispensing stations shall be in accordance with Chapter 20.
- 11.3.6 Combustible storage.** Combustible materials stored in aircraft hangars shall be stored in approved locations and containers.
- 11.3.7 Hazardous material storage.** Hazardous materials shall be stored in accordance with Chapter 25.

## SECTION 11.4 AIRCRAFT MAINTENANCE

- 11.4.1 Transferring flammable and combustible liquids.** Flammable and combustible liquids shall not be dispensed into or removed from a container, tank, vehicle or aircraft except in approved locations.
- 11.4.2 Application of flammable and combustible liquid finishes.** The application of flammable or Class II combustible liquid finishes is prohibited unless both of the following conditions are met:
- 1.** The application of the liquid finish is accomplished in an approved location.
  - 2.** The application methods and procedures are in accordance with Chapter 12.
- 11.4.3 Cleaning parts.** Class IA flammable liquids shall not be used to clean aircraft, aircraft parts or aircraft engines. Cleaning with other flammable and combustible liquids shall be in accordance with Section 32.5.3.6.
- 11.4.4 Spills.** This section shall apply to spills of flammable and combustible liquids and other hazardous materials. Fuel spill control shall also comply with Section 11.6.11.
- 11.4.4.1 Cessation of work.** Activities in the affected area not related to the mitigation of the spill shall cease until the spilled material has been removed or the hazard has been mitigated.
- 11.4.4.2 Vehicle movement.** Aircraft or other vehicles shall not be moved through the spill area until the spilled material has been removed or the hazard has been mitigated.
- 11.4.4.3 Mitigation.** Spills shall be reported, documented and mitigated in accordance with the provisions of this chapter and Section 25.3.3.
- 11.4.5 Running engines.** Aircraft engines shall not be run in aircraft hangars except in approved engine test areas.
- 11.4.6 Open flame.** Repairing of aircraft requiring the use of open flames, spark-producing devices or the heating of parts above 260°C shall only be done outdoors or in an area complying with the provisions of these code requirements and the SBC for a Group F-1 occupancy.

## SECTION 11.5

### PORTABLE FIRE EXTINGUISHERS

- 11.5.1 General.** Portable fire extinguishers suitable for flammable or combustible liquid and electrical-type fires shall be provided as specified in Sections 11.5.1 through 11.5.6 and Section 7.6. Extinguishers required by this section shall be inspected and maintained in accordance with Section 7.6.
- 11.5.2 On towing vehicles.** Vehicles used for towing aircraft shall be equipped with a minimum of one listed portable fire extinguisher complying with Section 7.6 and having a minimum rating of 20-B:C.
- 11.5.3 On welding apparatus.** Welding apparatus shall be equipped with a minimum of one listed portable fire extinguisher complying with Section 7.6 and having a minimum rating of 2-A:20-B:C.
- 11.5.4 On aircraft fuel-servicing tank vehicles.** Aircraft fuel-servicing tank vehicles shall be equipped with a minimum of two listed portable fire extinguishers complying with Section 7.6, each having a minimum rating of 20-B:C. A portable fire extinguisher shall be readily accessible from either side of the vehicle.
- 11.5.5 On hydrant fuel-servicing vehicles.** Hydrant fuel-servicing vehicles shall be equipped with a minimum of one listed portable fire extinguisher complying with Section 7.6, and having a minimum rating of 20-B:C.
- 11.5.6 At fuel-dispensing stations.** Portable fire extinguishers at fuel-dispensing stations shall be located such that pumps or dispensers are not more than 22.9 m from one such extinguisher. Fire extinguishers shall be provided as follows:
1. Where the open-hose discharge capacity of the fueling system is not more than 13 L/s, a minimum of two listed portable fire extinguishers complying with Section 7.6 and having a minimum rating of 20-B:C shall be provided.
  2. Where the open-hose discharge capacity of the fueling system is more than 13 L/s but not more than 22 L/s, a minimum of one listed wheeled extinguisher complying with Section 7.6 and having a minimum extinguishing rating of 80-B:C, and a minimum agent capacity of 57 kg, shall be provided.
  3. Where the open-hose discharge capacity of the fueling system is more than 22 L/s, a minimum of two listed wheeled extinguishers complying with Section 7.6 and having a minimum rating of 80-B:C each, and a minimum capacity agent of 57 kg of each, shall be provided.
- 11.5.7 Fire extinguisher access.** Portable fire extinguishers required by this chapter shall be accessible at all times. Where necessary, provisions shall be made to clear accumulations of snow, ice and other forms of weather-induced obstructions.
- 11.5.7.1 Cabinets.** Cabinets and enclosed compartments used to house portable fire extinguishers shall be clearly marked with the words FIRE EXTINGUISHER in letters at least 51 mm high. Cabinets and compartments shall be readily accessible at all times.
- 11.5.8 Reporting use.** Use of a fire extinguisher under any circumstances shall be reported to the manager of the airport and the Building code official immediately after use.

## SECTION 11.6 AIRCRAFT FUELING

- 11.6.1 Aircraft motor vehicle fuel-dispensing stations.** Aircraft motor vehicle fuel-dispensing stations shall be in accordance with Chapter 20.
- 11.6.2 Airport fuel systems.** Airport fuel systems shall be designed and constructed in accordance with NFPA 407.
- 11.6.3 Construction of aircraft-fueling vehicles and accessories.** Aircraft-fueling vehicles shall comply with this section and shall be designed and constructed in accordance with NFPA 407.
- 11.6.3.1 Transfer apparatus.** Aircraft-fueling vehicles shall be equipped and maintained with an approved transfer apparatus.
- 11.6.3.1.1 Internal combustion type.** Where such transfer apparatus is operated by an individual unit of the internal-combustion-motor type, such power unit shall be located as remotely as practicable from pumps, piping, meters, air eliminators, water separators, hose reels, and similar equipment, and shall be housed in a separate compartment from any of the aforementioned items. The fuel tank in connection therewith shall be suitably designed and installed, and the maximum fuel capacity shall not exceed 19 L where the tank is installed on the engine. The exhaust pipe, muffler and tail pipe shall be shielded.
- 11.6.3.1.2 Gear operated.** Where operated by gears or chains, the gears, chains, shafts, bearings, housing and all parts thereof shall be of an approved design and shall be installed and maintained in an approved manner.
- 11.6.3.1.3 Vibration isolation.** Flexible connections for the purpose of eliminating vibration are allowed if the material used therein is designed, installed and maintained in an approved manner, provided such connections do not exceed 6.1 m in length.
- 11.6.3.2 Pumps.** Pumps of a positive-displacement type shall be provided with a bypass relief valve set at a pressure of not more than 35 percent in excess of the normal working pressure of such unit. Such units shall be equipped and maintained with a pressure gauge on the discharge side of the pump.
- 11.6.3.3 Dispensing hoses and nozzles.** Hoses shall be designed for the transferring of hydrocarbon liquids and shall not be any longer than necessary to provide efficient fuel transfer operations. Hoses shall be equipped with an approved shutoff nozzle. Fuel-transfer nozzles shall be self-closing and designed to be actuated by hand pressure only. Notches and other devices shall not be used for holding a nozzle valve handle in the open position. Nozzles shall be equipped with a bonding cable complete with proper attachment for aircraft to be serviced.
- 11.6.3.4 Protection of electrical equipment.** Electric wiring, switches, lights and other sources of ignition, when located in a compartment housing piping, pumps, air eliminators, water separators, hose reels or similar equipment, shall be enclosed in a vapor-tight housing. Electrical motors located in such a compartment shall be of a type approved for use as specified in SBC 401.
- 11.6.3.5 Venting of equipment compartments.** Compartments housing piping, pumps, air eliminators, water separators, hose reels and similar equipment shall be adequately ventilated at floor level or within the floor itself.
- 11.6.3.6 Accessory equipment.** Ladders, hose reels and similar accessory equipment shall be of an approved type and constructed substantially as follows:
- 1.** Ladders constructed of noncombustible material are allowed to be used with or attached to aircraft-fueling vehicles, provided the manner of attachment or use of such ladders is approved and does not constitute an additional fire or

accident hazard in the operation of such fueling vehicles.

2. Hose reels used in connection with fueling vehicles shall be constructed of noncombustible materials and shall be provided with a packing gland or other device which will preclude fuel leakage between reels and fuel manifolds.

**11.6.3.7 Electrical bonding provisions.** Transfer apparatus shall be metallicity interconnected with tanks, chassis, axles and springs of aircraft-fueling vehicles.

**11.6.3.7.1 Bonding cables.** Aircraft-fueling vehicles shall be provided and maintained with a substantial heavy-duty electrical cable of sufficient length to be bonded to the aircraft to be serviced. Such cable shall be metallicity connected to the transfer apparatus or chassis of the aircraft-fueling vehicle on one end and shall be provided with a suitable metal clamp on the other end, to be fixed to the aircraft.

**11.6.3.7.2 Bonding cable protection.** The bonding cable shall be bare or have a transparent protective sleeve and be stored on a reel or in a compartment provided for no other purpose. It shall be carried in such a manner that it will not be subjected to sharp kinks or accidental breakage under conditions of general use.

**11.6.3.8 Smoking.** Smoking in aircraft-fueling vehicles is prohibited. Signs to this effect shall be conspicuously posted in the driver's compartment of all fueling vehicles.

**11.6.3.9 Smoking equipment.** Smoking equipment such as cigarette lighters and ashtrays shall not be provided in aircraft-fueling vehicles.

**11.6.4 Operation, maintenance and use of aircraft-fueling vehicles.** The operation, maintenance and use of aircraft-fueling vehicles shall be in accordance with Sections 11.6.4 through 11.6.4.4 and other applicable provisions of this chapter.

**11.6.4.1 Proper maintenance.** Aircraft-fueling vehicles and all related equipment shall be properly maintained and kept in good repair. Accumulations of oil, grease, fuel and other flammable or combustible materials is prohibited. Maintenance and servicing of such equipment shall be accomplished in approved areas.

**11.6.4.2 Vehicle integrity.** Tanks, pipes, hoses, valves and other fuel delivery equipment shall be maintained leak free at all times.

**11.6.4.3 Removal from service.** Aircraft-fueling vehicles and related equipment which are in violation of Section 11.6.4.1 or 11.6.4.2 shall be immediately defueled and removed from service and shall not be returned to service until proper repairs have been made.

**11.6.4.4 Operators.** Aircraft-fueling vehicles that are operated by a person, firm or corporation other than the permittee or the permittee's authorized employee shall be provided with a legible sign visible from outside the vehicle showing the name of the person, firm or corporation operating such unit.

**11.6.5 Fueling and defueling.** Aircraft-fueling and defueling operations shall be in accordance with Section 11.6.5.

**11.6.5.1 Positioning of aircraft fuel-servicing vehicles.** Aircraft-fueling vehicles shall not be located, parked or permitted to stand in a position where such unit would obstruct egress from an aircraft should a fire occur during fuel-transfer operations. Tank vehicles shall not be located, parked or permitted to stand under any portion of an aircraft.

**11.6.5.1.1 Fueling vehicle egress.** A clear path shall be maintained for aircraft-fueling vehicles to provide for prompt and timely egress from the fueling area.

**11.6.5.1.2 Aircraft vent openings.** A clear space of at least 3 m shall be maintained between aircraft fuel-system vent openings and any part or portion of an aircraft-fueling vehicle.

**11.6.5.1.3 Parking.** Prior to leaving the cab, the aircraft-fueling vehicle operator shall ensure that the parking brake has been set. At least two chock blocks not less than 127



mm by 127 mm by 305 mm in size and dished to fit the contour of the tires shall be utilized and positioned in such a manner as to preclude movement of the vehicle in any direction.

**11.6.5.2 Electrical bonding.** Aircraft-fueling vehicles shall be electrically bonded to the aircraft being fueled or defueled. Bonding connections shall be made prior to making fueling connections and shall not be disconnected until the fuel-transfer operations are completed and the fueling connections have been removed.

Where a hydrant service vehicle or cart is used for fueling, the hydrant coupler shall be connected to the hydrant system prior to bonding the fueling equipment to the aircraft.

**11.6.5.2.1 Conductive hose.** In addition to the bonding cable required by Section 11.6.5.2, conductive hose shall be used for all fueling operations.

**11.6.5.2.2 Bonding conductors on transfer nozzles.** Transfer nozzles shall be equipped with approved bonding conductors which shall be clipped or otherwise positively engaged with the bonding attachment provided on the aircraft adjacent to the fuel tank cap prior to removal of the cap.

**Exception:** In the case of overwing fueling where no appropriate bonding attachment adjacent to the fuel fill port has been provided on the aircraft, the fueling operator shall touch the fuel tank cap with the nozzle spout prior to removal of the cap. The nozzle shall be kept in contact with the fill port until fueling is completed.

**11.6.5.2.3 Funnels.** Where required, metal funnels are allowed to be used during fueling operations. Direct contact between the fueling receptacle, the funnel and the fueling nozzle shall be maintained during the fueling operation.

**11.6.5.3 Training.** Aircraft-fueling vehicles shall be attended and operated only by persons instructed in methods of proper use and operation and who are qualified to use such fueling vehicles in accordance with minimum safety requirements.

**11.6.5.3.1 Fueling hazards.** Fuel-servicing personnel shall know and understand the hazards associated with each type of fuel dispensed by the airport fueling-system operator.

**11.6.5.3.2 Fire safety training.** Employees of fuel agents, who fuel aircraft, accept fuel shipments or otherwise handle fuel shall receive approved fire safety training.

**11.6.5.3.2.1 Fire extinguisher training.** Fuel-servicing personnel shall receive approved training in the operation of fire-extinguishing equipment.

**11.6.5.3.2.2 Documentation.** The airport fueling-system operator shall maintain records of all training administered to its employees. These records shall be made available to the Building code official on request.

**11.6.5.4 Transfer personnel.** During fuel-transfer operations, a qualified person shall be in control of each transfer nozzle and another qualified person shall be in immediate control of the fuel-pumping equipment to shutoff or otherwise control the flow of fuel from the time fueling operations are begun until they are completed.

**Exceptions:**

1. For underwing refueling, the person stationed at the point of fuel intake is not required.
2. For overwing refueling, the person stationed at the fuel pumping equipment shall not be required where the person at the fuel dispensing device is within 22.8 m of the emergency shutoff device, is not on the wing of the aircraft and has a clear and unencumbered path to the fuel pumping equipment; and, the fuel dispensing line does not exceed 15.2 m in length.

The fueling operator shall monitor the panel of the fueling equipment and the aircraft control panel during pressure fueling or shall monitor the fill port during overwing fueling.

- 11.6.5.5 Fuel flow control.** Fuel flow-control valves shall be operable only by the direct hand pressure of the operator. Removal of the operator's hand pressure shall cause an immediate cessation of the flow of fuel.
- 11.6.6 Emergency fuel shutoff.** Emergency fuel shutoff controls and procedures shall comply with Sections 11.6.6.1 through 11.6.6.4.
- 11.6.6.1 Accessibility.** Emergency fuel shutoff controls shall be readily accessible at all times when the fueling system is being operated.
- 11.6.6.2 Notification of the Civil Defence.** The fueling-system operator shall establish a procedure by which the Civil Defence will be notified in the event of an activation of an emergency fuel shutoff control.
- 11.6.6.3 Determining cause.** Prior to reestablishment of normal fuel flow, the cause of fuel shutoff conditions shall be determined and corrected.
- 11.6.6.4 Testing.** Emergency fuel shutoff devices shall be operationally tested at intervals not exceeding three months. The fueling-system operator shall maintain suitable records of these tests.
- 11.6.7 Protection of hoses.** Before an aircraft-fueling vehicle is moved, fuel transfer hoses shall be properly placed on the approved reel or in the compartment provided, or stored on the top decking of the fueling vehicle if proper height rail is provided for security and protection of such equipment. Fuel-transfer hose shall not be looped or draped over any part of the fueling vehicle, except as herein provided. Fuel-transfer hose shall not be dragged when such fueling vehicle is moved from one fueling position to another.
- 11.6.8 Loading and unloading.** Aircraft-fueling vehicles shall be loaded only at an approved loading rack. Such loading racks shall be in accordance with Section 32.6.5.1.12.
- Exceptions:**
1. Aircraft-refueling units may be loaded from the fuel tanks of an aircraft during defueling operations.
  2. Fuel transfer between tank vehicles is allowed to be performed in accordance with Section 32.6.6 when the operation is at least 61 m from an aircraft.
- The fuel cargo of such units shall be unloaded only by approved transfer apparatus into the fuel tanks of aircraft, underground storage tanks or approved gravity storage tanks.
- 11.6.9 Passengers.** Passenger traffic is allowed during the time fuel transfer operations are in progress, provided the following provisions are strictly enforced by the owner of the aircraft or the owner's authorized employee:
1. Smoking and producing an open flame in the cabin of the aircraft or the outside thereof within 15.2 m of such aircraft shall be prohibited.  
A qualified employee of the aircraft owner shall be responsible for seeing that the passengers are not allowed to smoke when remaining aboard the aircraft or while going across the ramp from the gate to such aircraft, or vice versa.
  2. Passengers shall not be permitted to linger about the plane, but shall proceed directly between the loading gate and the aircraft.
  3. Passenger loading stands or walkways shall be left in loading position until all fuel transfer operations are completed.
  4. Fuel transfer operations shall not be performed on the main exit side of any aircraft containing passengers except when the owner of such aircraft or a capable and qualified employee of such owner remains inside the aircraft to direct and assist the escape of such passengers through regular and emergency

exits in the event fire should occur during fuel transfer operations.

- 11.6.10 Sources of ignition.** Smoking and producing open flames within 15.2 m of a point where fuel is being transferred shall be prohibited. Electrical and motor-driven devices shall not be connected to or disconnected from an aircraft at any time fueling operations are in progress on such aircraft.
- 11.6.11 Fuel spill prevention and procedures.** Fuel spill prevention and the procedures for handling spills shall comply with Sections 11.6.11.1 through 11.6.11.7.
- 11.6.11.1 Fuel-service equipment maintenance.** Aircraft fuel-servicing equipment shall be maintained and kept free from leaks. Fuel-servicing equipment that malfunctions or leaks shall not be continued in service.
- 11.6.11.2 Transporting fuel nozzles.** Fuel nozzles shall be carried utilizing appropriate handles. Dragging fuel nozzles along the ground shall be prohibited.
- 11.6.11.3 Drum fueling.** Fueling from drums or other containers having a capacity greater than 19 L shall be accomplished with the use of an approved pump.
- 11.6.11.4 Fuel spill procedures.** The fueling-system operator shall establish procedures to follow in the event of a fuel spill. These procedures shall be comprehensive and shall provide for at least all of the following:
1. Upon observation of a fuel spill, the aircraft-fueling operator shall immediately stop the delivery of fuel by releasing hand pressure from the fuel flow-control valve.
  2. Failure of the fuel control valve to stop the continued spillage of fuel shall be cause for the activation of the appropriate emergency fuel shutoff device.
  3. A supervisor for the fueling-system operator shall respond to the fuel spill area immediately.
- 11.6.11.5 Notification of the Civil Defence.** The Civil Defence shall be notified of any fuel spill which is considered a hazard to people or property or which meets one or more of the following criteria:
1. Any dimension of the spill is greater than 3 m.
  2. The spill area is greater than 4.65 m<sup>2</sup>.
  3. The fuel flow is continuous in nature.
- 11.6.11.6 Investigation required.** An investigation shall be conducted by the fueling-system operator of all spills requiring notification of the Civil Defence. The investigation shall provide conclusive proof of the cause and verification of the appropriate use of emergency procedures. Where it is determined that corrective measures are necessary to prevent future incidents of the same nature, they shall be implemented immediately.
- 11.6.11.7 Multiple fuel delivery vehicles.** Simultaneous delivery of fuel from more than one aircraft-fueling vehicle to a single aircraft-fueling manifold is prohibited unless proper backflow prevention devices are installed to prevent fuel flow into the tank vehicles.
- 11.6.12 Aircraft engines and heaters.** Operation of aircraft onboard engines and combustion heaters shall be terminated prior to commencing fuel service operations and shall remain off until the fuel-servicing operation is completed.
- Exception:** In an emergency, a single jet engine is allowed to be operated during fuel servicing where all of the following conditions are met:
1. The emergency shall have resulted from an onboard failure of the aircraft's auxiliary power unit.
  2. Restoration of auxiliary power to the aircraft by ground support services is not available.

3. The engine to be operated is either at the rear of the aircraft or on the opposite side of the aircraft from the fuel service operation.
4. The emergency operation is in accordance with a written procedure approved by the Building code official.

**11.6.13 Vehicle and equipment restrictions.** During aircraft-fueling operations, only the equipment actively involved in the fueling operation is allowed within 15.2 m of the aircraft being fueled. Other equipment shall be prohibited in this area until the fueling operation is complete.

**Exception:** Aircraft-fueling operations utilizing single-point refueling with a sealed, mechanically locked fuel line connection and the fuel is not a Class I flammable liquid.

A clear space of at least 3 m shall be maintained between aircraft fuel-system vent openings and any part or portion of aircraft-servicing vehicles or equipment.

**11.6.13.1 Overwing fueling.** Vehicles or equipment shall not be allowed beneath the trailing edge of the wing when aircraft fueling takes place over the wing and the aircraft fuel-system vents are located on the upper surface of the wing.

**11.6.14 Electrical equipment.** Electrical equipment, including but not limited to, battery chargers, ground or auxiliary power units, fans, compressors or tools, shall not be operated, nor shall they be connected or disconnected from their power source, during fuel service operations.

**11.6.14.1 Other equipment.** Electrical or other spark-producing equipment shall not be used within 3 m of fueling equipment, aircraft fill or vent points, or spill areas unless that equipment is intrinsically safe and approved for use in an explosive atmosphere.

**11.6.15 Open flames.** Open flames and open-flame devices are prohibited within 15.2 m of any aircraft fuel-servicing operation or fueling equipment.

**11.6.15.1 Other areas.** The Building code official is authorized to establish other locations where open flames and open-flame devices are prohibited.

**11.6.15.2 Matches and lighters.** Personnel assigned to and engaged in fuel-servicing operations shall not carry matches or lighters on or about their person. Matches or lighters shall be prohibited in, on or about aircraft-fueling equipment.

**11.6.16 Lightning procedures.** The Building code official is authorized to require the airport authority and the fueling-system operator to establish written procedures to follow when lightning flashes are detected on or near the airport. These procedures shall establish criteria for the suspension and resumption of aircraft-fueling operations.

**11.6.17 Fuel-transfer locations.** Aircraft fuel-transfer operations shall be prohibited indoors.

**Exception:** In aircraft hangars built in accordance with the provisions of these code requirements for Group F-1 occupancies, aircraft fuel-transfer operations are allowed where:

1. Necessary to accomplish aircraft fuel-system maintenance operations. Such operations shall be performed in accordance with nationally recognized standards; or
2. The fuel being used has a flash point greater than 37.8°C.

**11.6.17.1 Position of aircraft.** Aircraft being fueled shall be positioned such that any fuel system vents and other fuel tank openings are a minimum of:

1. 7.6 m from buildings or structures other than jet bridges; and
  2. 15.2 m from air intake vents for boiler, heater or incinerator rooms.
- 11.6.17.2 Fire equipment access.** Access for fire service equipment to aircraft shall be maintained during fuel-servicing operations.
- 11.6.18 Defueling operations.** The requirements for fueling operations contained in this section shall also apply to aircraft defueling operations. Additional procedures shall be established by the fueling-system operator to prevent overfilling of the tank vehicle used in the defueling operation.
- 11.6.19 Maintenance of aircraft-fueling hose.** Aircraft-fueling hoses shall be maintained in accordance with Sections 11.6.19.1 through 11.6.19.4.
- 11.6.19.1 Inspections.** Hoses used to fuel or defuel aircraft shall be inspected periodically to ensure their serviceability and suitability for continued service. The fuel-service operator shall maintain records of all tests and inspections performed on fueling hoses. Hoses found to be defective or otherwise damaged shall be immediately removed from service.
- 11.6.19.1.1 Daily inspection.** Each hose shall be inspected daily. This inspection shall include a complete visual scan of the exterior for evidence of damage, blistering or leakage. Each coupling shall be inspected for evidence of leaks, slippage or misalignment.
- 11.6.19.1.2 Monthly inspection.** A more thorough inspection, including pressure testing, shall be accomplished for each hose on a monthly basis. This inspection shall include examination of the fuel delivery inlet screen for rubber particles, which indicates problems with the hose lining.
- 11.6.19.2 Damaged hose.** Hose that has been subjected to severe abuse shall be immediately removed from service. Such hoses shall be hydrostatically tested prior to being returned to service.
- 11.6.19.3 Repairing hose.** Hoses are allowed to be repaired by removing the damaged portion and recoupling the undamaged end. When recoupling hoses, only couplings designed and approved for the size and type of hose in question shall be used. Hoses repaired in this manner shall be visually inspected and hydrostatically tested prior to being placed back in service.
- 11.6.19.4 New hose.** New hose shall be visually inspected prior to being placed into service.
- 11.6.20 Aircraft fuel-servicing vehicles parking.** Unattended aircraft fuel-servicing vehicles shall be parked in areas that provide for both the unencumbered dispersal of vehicles in the event of an emergency and the control of leakage such that adjacent buildings and storm drains are not contaminated by leaking fuel.
- 11.6.20.1 Parking area design.** Parking areas for tank vehicles shall be designed and utilized such that a clearance of 3 m is maintained between each parked vehicle for Civil Defence access. In addition, a minimum clearance of 15.2 m shall be maintained between tank vehicles and parked aircraft and structures other than those used for the maintenance and/or garaging of aircraft fuel-servicing vehicles.
- 11.6.21 Radar equipment.** Aircraft fuel-servicing operations shall be prohibited while the weather-mapping radar of that aircraft is operating.  
Aircraft fuel-servicing or other operations in which flammable liquids, vapors or mists may be present shall not be conducted within 91.4 m of an operating aircraft surveillance radar.  
Aircraft fuel-servicing operations shall not be conducted within 91.4 m of airport flight traffic surveillance radar equipment.

Aircraft fuel-servicing or other operations in which flammable liquids, vapors or mists may be present shall not be conducted within 30.5 m of airport ground traffic surveillance radar equipment.

- 11.6.21.1 Direction of radar beams.** The beam from ground radar equipment shall not be directed toward fuel storage or loading racks.

**Exceptions:**

1. Fuel storage and loading racks in excess of 91.4 m from airport flight traffic surveillance equipment.
2. Fuel storage and loading racks in excess of 30.5 m from airport ground traffic surveillance equipment.

## **SECTION 11.7 HELISTOPS AND HELIPORTS**

- 11.7.1 General.** Helistops and heliports shall be maintained in accordance with Section 11.7. Helistops and heliports on buildings shall be constructed in accordance with SBC 201.
- 11.7.2 Clearances.** The touchdown area shall be surrounded on all sides by a clear area having minimum average width at roof level of 4.6 m but no width less than 1.5 m. The clear area shall be maintained.
- 11.7.3 Flammable and Class II combustible liquid spillage.** Landing areas on structures shall be maintained so as to confine flammable or Class II combustible liquid spillage to the landing area itself, and provisions shall be made to drain such spillage away from exits or stairways serving the helicopter landing area or from a structure housing such exit or stairway.
- 11.7.4 Exits.** Exits and stairways shall be maintained in accordance with Section 2.25.5 of the SBC 201.
- 11.7.5 Standpipe systems.** Where a building with a rooftop helistop or heliport is equipped with a standpipe system, the system shall be extended to the roof level on which the helistop or heliport is located. All portions of the helistop and heliport area shall be within 45.7 m of a 65 mm outlet on a Class I or III standpipe.
- 11.7.6 Foam protection.** Foam fire-protection capabilities shall be provided for rooftop heliports. Such systems shall be designed, installed and maintained in accordance with the applicable provisions of Sections 7.3, 7.4 and 7.5.
- 11.7.7 Fire extinguishers.** A minimum of one portable fire extinguisher having a minimum 80-B:C rating shall be provided for each permanent takeoff and landing area and for the aircraft parking areas. Installation, inspection and maintenance of these extinguishers shall be in accordance with Section 7.6.
- 11.7.8 Local approval.** Before operating helicopters from helistops and heliports, approval shall be obtained from the Civil Aviation Administration.

## CHAPTER 12 FLAMMABLE FINISHES

### SECTION 12.1 GENERAL

- 12.1.1 Scope.** This chapter shall apply to locations or areas where any of the following activities are conducted:
1. The application of flammable or combustible paint, varnish, lacquer, stain, fiberglass resins or other flammable or combustible liquid applied by means of spray apparatus in continuous or intermittent processes.
  2. Dip-tank operations in which articles or materials are passed through contents of tanks, vats or containers of flammable or combustible liquids, including coating, finishing, treatment and similar processes.
  3. The application of combustible powders when applied by powder spray guns, electrostatic powder spray guns, fluidized beds or electrostatic fluidized beds.
  4. Floor surfacing or finishing operations in areas exceeding 32.5 m<sup>2</sup>.
  5. The application of dual-component coatings or Class I or II liquids when applied by brush or roller in quantities exceeding 4 L.
  6. Spraying and dipping operations.
- 12.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 12.2 DEFINITIONS

- 12.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**DETEARING.** A process for rapidly removing excess wet coating material from a dipped or coated object or material by passing it through an electrostatic field.

**DIP TANK.** A tank, vat or container of flammable or combustible liquid in which articles or materials are immersed for the purpose of coating, finishing, treating and similar processes.

**ELECTROSTATIC FLUIDIZED BED.** A container holding powder coating material that is aerated from below so as to form an air-supported expanded cloud of such material which is electrically charged with a charge opposite to the charge of the object to be coated. Such object is transported through the container immediately above the charged and aerated materials in order to be coated.

**FLAMMABLE FINISHES.** Material coatings in which the material being applied is a flammable liquid, combustible liquid, combustible powder or flammable or combustible gel coatings.

**FLUIDIZED BED.** A container holding powder coating material that is aerated from below so as to form an air-supported expanded cloud of such material through which the preheated object to be coated is immersed and transported.

**LIMITED SPRAYING SPACE.** An area in which spraying operations for touch-up or spot painting of a surface area of  $0.84 \text{ m}^2$  or less are conducted.

**RESIN APPLICATION AREA.** An area where reinforced plastics are used to manufacture products by hand lay-up or spray-fabrication methods.

**ROLL COATING.** The process of coating, spreading and impregnating fabrics, paper or other materials as they are passed directly through a tank or trough containing flammable or combustible liquids, or over the surface of a roller revolving partially submerged in a flammable or combustible liquid.

**SPRAY AREA.** An area in which dangerous quantities of flammable vapors or combustible residues, dusts or deposits are present because of the operation of spraying processes. It shall include the interior of spray booths, the interior of ducts exhausting from spraying processes, or any area in the direct path of spray or any area containing dangerous quantities of air-suspended powder, combustible residue, dust, deposits, vapor or mists as a result of spraying operations. The building code official is authorized to define the spray area in any specific case.

**SPRAY BOOTH.** A mechanically ventilated appliance of varying dimensions and construction provided to enclose or accommodate a spraying operation and to confine and limit the escape of spray vapor and residue and to exhaust it safely.

**SPRAY ROOM.** A room designed to accommodate spraying operations constructed in accordance with the SBC 100 and separated from the remainder of the building by a minimum 1 hour fire barrier.

**VAPOR AREA.** An area containing flammable vapors in the vicinity of dip tanks, drain boards or associated drying, conveying or other equipment during operation or shutdown periods. The building code official is authorized to determine the extent of the vapor area, taking into consideration the characteristics of the liquid, the degree of sustained ventilation and the nature of the operations.

## SECTION 12.3 PROTECTION OF OPERATIONS

- 12.3.1 General.** Operations covered by this chapter shall be protected as required by this section.
- 12.3.2 Sources of ignition.** Protection against sources of ignition shall be provided in accordance with Sections 12.3.2.1 through 12.3.2.8.
- 12.3.2.1 Electrical wiring and equipment.** Electrical wiring and equipment shall comply with this chapter and the SBC 401.
- 12.3.2.1.1 Spray spaces and vapor areas.** Electrical wiring and equipment in spray spaces and vapor areas shall be of an explosion-proof type approved for use in such hazardous locations. Such areas shall be considered to be Class I, Division 1 or Class II, Division 1 hazardous locations in accordance with the SBC 401.
- 12.3.2.1.2 Electrical wiring and equipment in resin application areas.** Electrical wiring and equipment located in resin application areas shall be in accordance with the SBC 401.
- 12.3.2.1.3 Areas subject to deposits of residues.** Electrical equipment in the vicinity of spray areas and dip tanks or associated drain boards or drying operations which are



subject to splashing or dripping of liquids shall be specifically approved for locations containing deposits of readily ignitable residue and explosive vapors.

**Exceptions:**

1. This provision shall not apply to wiring in rigid conduit, threaded boxes or fittings not containing taps, splices or terminal connections.
2. This provision shall not apply to electrostatic equipment allowed by Section 12.6.

In resin application areas, electrical wiring and equipment that is subject to deposits of combustible residues shall be listed for such exposure and shall be installed as required for hazardous (classified) locations. Electrical wiring and equipment not subject to deposits of combustible residues shall be installed as required for ordinary hazard locations.

**12.3.2.1.4 Areas adjacent to spray booths.** Electrical wiring and equipment located outside of, but within 1.5 m horizontally and 900 mm vertically of openings in a spray booth or a spray room shall be approved for Class I, Division 2 or Class II, Division 2 hazardous locations, whichever is applicable.

**12.3.2.1.5 Areas subject to overspray deposits.** Electrical equipment in spraying areas located such that deposits of combustible residues could readily accumulate thereon shall be specifically approved for locations containing deposits of readily ignitable residue and explosive vapors in accordance with the SBC 401.

**Exceptions:**

1. Wiring in rigid conduit.
2. Boxes or fittings not containing taps, splices or terminal connections.
3. Equipment allowed by Sections 12.4 and 12.6 and Chapter 19.

**12.3.2.1.6 Flexible power cords.** The use of flexible power cords shall be in accordance with the SBC 401.

**12.3.2.2 Open flames and sparks.** Open flames and spark-producing devices shall not be located in spray spaces or vapor areas and shall not be located within 6.1 m of such areas unless separated by a permanent partition.

**Exception:** Drying and baking apparatus complying with Section 12.4.7.2.

**12.3.2.3 Hot surfaces.** Heated surfaces having a temperature sufficient to ignite vapors shall not be located in vapor areas. Space-heating appliances, steam pipes or hot surfaces in a spraying area or a resin application area shall be located such that they are not subject to accumulation of deposits of combustible residues.

**Exception:** Drying apparatus complying with Section 12.4.7.2.

**12.3.2.4 Equipment enclosures.** Equipment or apparatus that is capable of producing sparks or particles of hot metal that would fall into a spray space or vapor area shall be totally enclosed.

**12.3.2.5 Grounding.** Metal parts of spray booths, exhaust ducts and piping systems conveying Class I or II liquids shall be electrically grounded in accordance with the SBC 401. Metallic parts located in resin application areas, including but not limited to exhaust ducts, ventilation fans, spray application equipment, work pieces and piping shall be electrically grounded.

**12.3.2.6 Smoking prohibited.** Smoking shall be prohibited in spray spaces or vapor areas. "No Smoking" signs complying with Chapter 15 of the SBC 201 shall be conspicuously posted in such areas.

**12.3.2.7 Welding warning signs.** Welding, cutting and similar spark-producing operations shall not be conducted in or adjacent to spray areas or dipping or coating operations unless precautions have been taken to provide safety. Conspicuous signs with the following warning shall be posted in the vicinity of spraying areas, dipping operations and paint storage rooms:

NO WELDING: THE USE OF WELDING OR CUTTING EQUIPMENT IN OR NEAR THIS AREA IS DANGEROUS BECAUSE OF FIRE AND EXPLOSION HAZARDS. WELDING AND CUTTING SHALL BE DONE ONLY UNDER THE SUPERVISION OF THE PERSON IN CHARGE.

- 12.3.2.8 Powered industrial trucks.** Powered industrial trucks used in electrically classified areas shall be listed for such use.
- 12.3.3 Storage, use and handling of flammable and combustible liquids.** The storage, use and handling of flammable and combustible liquids shall be in accordance with this section and Chapter 32.
- 12.3.3.1 Use.** Containers supplying spray nozzles shall be of a closed type or provided with metal covers which are kept closed. Containers not resting on floors shall be on noncombustible supports or suspended by wire cables. Containers supplying spray nozzles by gravity flow shall not exceed 37.9 L in capacity.
- 12.3.3.2 Valves.** Containers and piping to which a hose or flexible connection is attached shall be provided with a shut-off valve at the connection. Such valves shall be kept shut when hoses are not in use.
- 12.3.3.3 Pumped liquid supplies.** Where flammable or combustible liquids are supplied to spray nozzles by positive displacement pumps, pump discharge lines shall be provided with an approved relief valve discharging to pump suction or a safe detached location.
- 12.3.3.4 Liquid transfer.** Where a flammable mixture is transferred from one portable container to another, a bond shall be provided between the two containers. At least one container shall be grounded. Piping systems for Class I and Class II liquids shall be permanently grounded.
- 12.3.3.5 Class I liquids as solvents.** Class I liquids used as solvents shall be used in spray gun and equipment cleaning machines which have been listed and approved for the purpose or shall be used in spray booths or spray rooms in accordance with Sections 12.3.3.5.1 and 12.3.3.5.2.
- 12.3.3.5.1 Listed devices.** Cleaning machines for spray guns and equipment shall not be located in areas open to the public and shall be separated from ignition sources in accordance with their listings or by a distance of 900 mm, whichever is greater. The quantity of solvent used in a machine shall not exceed the design capacity of the machine.
- 12.3.3.5.2 Within spray booths and spray rooms.** When solvents are used for cleaning spray nozzles and auxiliary equipment within spray booths and spray rooms, the ventilating equipment shall be operated during cleaning.
- 12.3.3.6 Class II and Class III liquids.** Solvents used outside of spray booths, spray rooms or listed and approved spray gun and equipment cleaning machines shall be restricted to Class II and Class III liquids.
- 12.3.4 Operations and maintenance.** Spraying areas, exhaust fan blades and exhaust ducts shall be kept free from the accumulation of deposits of combustible residues. Where excessive residue accumulates in booths, ducts, or discharge points or other spraying areas, spraying operations shall be discontinued until conditions are corrected.
- 12.3.4.1 Tools.** Scrapers, spuds and other tools used for cleaning purposes shall be constructed of nonsparking materials.
- 12.3.4.2 Residue.** Residues removed during cleaning and debris contaminated with residue shall be immediately removed from the premises and properly disposed.

- 12.3.4.3 Waste cans.** Approved metal waste cans equipped with self-closing lids shall be provided wherever rags or waste are impregnated with finishing material. Such rags and waste shall be deposited therein immediately after being utilized. The contents of waste cans shall be properly disposed of at least once daily and at the end of each shift.
- 12.3.4.4 Solvent recycling.** Solvent distillation equipment used to recycle and clean dirty solvents shall comply with Section 32.5.4.

## SECTION 12.4 SPRAY FINISHING

- 12.4.1 Location of spray-finishing operations.** Spray-finishing operations conducted in buildings used for Group A, E, I or R occupancies shall be located in a spray room protected with an approved automatic sprinkler system installed in accordance with Section 7.3 and separated vertically and horizontally from other areas. In other occupancies, spray-finishing operations shall be conducted in a spray room, spray booth or limited spraying space approved for such use.
- 12.4.1.1 Spray rooms.** Spray rooms shall be constructed and designed in accordance with this section and the SBC 100, and shall comply with Sections 12.4.2, 12.4.3, 12.4.4, 12.4.5 and 12.4.6.
- 12.4.1.1.1 Floor.** Combustible floor construction in spray rooms shall be covered by approved, noncombustible, nonsparking material, except where combustible coverings, such as thin paper or plastic and strippable coatings are utilized over noncombustible materials to facilitate cleaning operations in spray rooms.
- 12.4.1.2 Spray booths.** The design and construction of spray booths shall be in accordance with Sections 12.4.1.2.1 through 12.4.1.2.6, Sections 12.4.2 through 12.4.6, and NFPA 33.
- 12.4.1.2.1 Construction.** Spray booths shall be constructed of approved noncombustible materials. Aluminum shall not be used.  
Where walls or ceiling assemblies are constructed of sheet metal, single-skin assemblies shall be no thinner than 1.2 mm (18 gage) and each sheet of double-skin assemblies shall be no thinner than 0.9 mm (20 gage).  
Structural sections of spray booths are allowed to be sealed with latex-based or similar caulks and sealants.
- 12.4.1.2.2 Surfaces.** The interior surfaces of spray booths shall be smooth and shall be constructed so as to permit the free passage of exhaust air from all parts of the interior and to facilitate washing and cleaning, and shall be designed to confine residues within the booth. Aluminum shall not be used.
- 12.4.1.2.3 Floor.** Combustible floor construction in spray booths shall be covered by approved, noncombustible, nonsparking material, except where combustible coverings, such as thin paper or plastic and strippable coatings are utilized over noncombustible materials to facilitate cleaning operations in spray booths.
- 12.4.1.2.4 Means of egress.** Means of egress shall be provided in accordance with Chapter 8.  
**Exception:** Means of egress doors from premanufactured spray booths shall not be less than 760 mm in width by 2.0 m in height.
- 12.4.1.2.5 Clear space.** Spray booths shall be installed so that all parts of the booth are readily accessible for cleaning. A clear space of not less than 900 mm shall be maintained on all sides of the spray booth. This clear space shall be kept free of any storage or combustible construction.
- Exceptions:**
1. This requirement shall not prohibit locating a spray booth closer than 900 mm to or directly against an interior partition, wall or floor/ceiling assembly, that

has a fire-resistance-rating of not less than 1 hour, provided the spray booth can be adequately maintained and cleaned.

2. This requirement shall not prohibit locating a spray booth closer than 900 mm to an exterior wall or a roof assembly provided the wall or roof is constructed of noncombustible material and provided the spray booth can be adequately maintained and cleaned.

**12.4.1.2.6 Size.** The aggregate area of spray booths in a building shall not exceed the lesser of 10 percent of the area of any floor of a building or the basic area allowed for a Group H-2 occupancy without area increases, as set forth in the SBC 201. The area of an individual spray booth in a building shall not exceed the lesser of the aggregate size limit or 139 m<sup>2</sup>.

**Exception:** One individual booth not exceeding 46 m<sup>2</sup>.

**12.4.1.3 Spraying spaces.** Spraying spaces shall be designed and constructed in accordance with the SBC 100 and Sections 12.4.1.3.1, 12.4.2, 12.4.3, 12.4.4, 12.4.5 and 12.4.6 of these code requirements.

**12.4.1.3.1 Floor.** Combustible floor construction in spraying spaces shall be covered by approved, noncombustible, nonsparking material, except where combustible coverings, such as thin paper or plastic and strippable coatings are utilized over noncombustible materials to facilitate cleaning operations in spraying spaces.

**12.4.1.4 Limited spraying spaces.** Limited spraying spaces shall comply with Sections 12.4.1.4.1 through 12.4.1.4.4.

**12.4.1.4.1 Job size.** The aggregate surface area to be sprayed shall not exceed 0.84 m<sup>2</sup>.

**12.4.1.4.2 Frequency.** Spraying operations shall not be of a continuous nature.

**12.4.1.4.3 Ventilation.** Positive mechanical ventilation providing a minimum of six complete air changes per hour shall be installed. Such system shall meet these code requirements for handling flammable vapors. Explosion venting is not required.

**12.4.1.4.4 Electrical wiring.** Electrical wiring within 3.1 m of the floor and 6.1 m horizontally of the limited spraying space shall be designed for Class I, Division 2 locations in accordance with the SBC 401.

**12.4.2 Ventilation.** Mechanical ventilation of spraying areas shall be provided in accordance with SBC 501.

**12.4.2.1 Operation.** Mechanical ventilation shall be kept in operation at all times while spraying operations are being conducted and for a sufficient time thereafter to allow vapors from drying coated articles and finishing material residue to be exhausted. Spraying equipment shall be interlocked with the ventilation of the spraying area such that spraying operations cannot be conducted unless the ventilation system is in operation.

**12.4.2.2 Recirculation.** Air exhausted from spraying operations shall not be recirculated.

**Exceptions:**

1. Air exhausted from spraying operations is allowed to be recirculated as makeup air for unmanned spray operations provided that:

- 1.1 The solid particulate has been removed.

- 1.2 The vapor concentration is less than 25 percent of the LFL.

- 1.3 Approved equipment is used to monitor the vapor concentration.

- 1.4 When the vapor concentration exceeds 25 percent of the LFL, the following shall occur:

- a. An alarm shall sound; and

- b. Spray operations shall automatically shut down.

- 1.5 In the event of shutdown of the vapor concentration monitor, 100 percent of the air volume specified in Section 12.4.2 is automatically exhausted.

2. Air exhausted from spraying operations is allowed to be recirculated as makeup air to manned spraying operations where all of the conditions provided in Exception 1 are included in the installation and documents have been prepared to show that the installation does not pose a life safety hazard to personnel inside the spray booth, spray space or spray room.

**12.4.2.3 Air velocity.** Ventilation systems shall be designed, installed and maintained such that the average air velocity over the open face of the booth, or booth cross sectional in the direction of airflow during spraying operations, shall not be less than 51 m/s.

**12.4.2.4 Ventilation obstruction.** Articles being sprayed shall be positioned in a manner that does not obstruct collection of overspray.

**12.4.2.5 Independent ducts.** Each spray booth and spray room shall have an independent exhaust duct system discharging to the outside.

**Exceptions:**

1. Multiple spray booths having a combined frontal area of 1.67 m<sup>2</sup> or less are allowed to have a common exhaust when identical spray-finishing material is used in each booth. If more than one fan serves one booth, fans shall be interconnected such that all fans operate simultaneously.
2. Where treatment of exhaust is necessary for air pollution control or for energy conservation, ducts shall be allowed to be manifolded if all of the following conditions are met:
  - 2.1 The sprayed materials used are compatible and will not react or cause ignition of the residue in the ducts.
  - 2.2 Nitrocellulose-based finishing material shall not be used.
  - 2.3 A filtering system shall be provided to reduce the amount of overspray carried into the duct manifold.
  - 2.4 Automatic sprinkler protection shall be provided at the junction of each booth exhaust with the manifold, in addition to the protection required by this chapter.

**12.4.2.6 Termination point.** The termination point for exhaust ducts discharging to the atmosphere shall not be less than the following distances:

1. Ducts conveying explosive or flammable vapors, fumes or dusts: 9.1 m from the property line; 3.1 m from openings into the building; 1.8 m from exterior walls and roofs; 9.1 m from combustible walls or openings into the building which are in the direction of the exhaust discharge; 3.1 m above adjoining grade.
2. Other product-conveying outlets: 3.1 m from the property line; 900 mm from exterior walls and roofs; 3.1 m from openings into the building; 3.1 m above adjoining grade.
3. Environmental air duct exhaust: 0.9 m from the property line; 900 mm from openings into the building.

**12.4.2.7 Fan motors and belts.** Electric motors driving exhaust fans shall not be placed inside booths or ducts. Fan rotating elements shall be nonferrous or nonsparking or the casing shall consist of, or be lined with, such material. Belts shall not enter the duct or booth unless the belt and pulley within the duct are tightly enclosed.

**12.4.3 Filters.** Air intake filters that are part of a wall or ceiling assembly shall be listed as Class I or Class II in accordance with SBC 501. Exhaust filters shall be required.

**12.4.3.1 Supports.** Supports and holders for filters shall be constructed of noncombustible materials.

- 12.4.3.2 Attachment.** Overspray collection filters shall be readily removable and accessible for cleaning or replacement.
- 12.4.3.3 Maintaining air velocity.** Visible gauges, audible alarms or pressure-activated devices shall be installed to indicate or ensure that the required air velocity is maintained.
- 12.4.3.4 Filter rolls.** Spray booths equipped with a filter roll that is automatically advanced when the air velocity is reduced to less than 51 m/s shall be arranged to shut down the spraying operation if the filter roll fails to advance automatically.
- 12.4.3.5 Filter disposal.** Discarded filter pads shall be immediately removed to a safe, detached location or placed in a noncombustible container with a tight-fitting lid and disposed of properly.
- 12.4.3.6 Spontaneous ignition.** Spray booths using dry filters shall not be used for spraying materials that are highly susceptible to spontaneous heating and ignition. Filters shall be changed prior to spraying materials that could react with other materials previously collected. Examples of potentially reactive combinations include lacquer when combined with varnishes, stains or primers.
- 12.4.3.7 Waterwash spray booths.** Waterwash spray booths shall be of an approved design so as to prevent excessive accumulation of deposits in ducts and residue at duct outlets. Such booths shall be arranged so that air and overspray are drawn through a continuously flowing water curtain before entering an exhaust duct to the building exterior.
- 12.4.4 Different coatings.** Spray booths, spray rooms and spray spaces shall not be alternately utilized for different types of coating materials where the combination of materials is conducive to spontaneous ignition, unless all deposits of one material are removed from the booth, room or space and exhaust ducts prior to spraying with a different material.
- 12.4.5 Illumination.** Where spraying spaces, spray rooms or spray booths are illuminated through glass panels or other transparent materials, only fixed lighting units shall be utilized as a source of illumination.
- 12.4.5.1 Glass panels.** Panels for light fixtures or for observation shall be of heat-treated glass, wired glass or hammered-wire glass and shall be sealed to confine vapors, mists, residues, dusts and deposits to the spraying area. Panels for light fixtures shall be separated from the fixture to prevent the surface temperature of the panel from exceeding 93°C.
- 12.4.5.2 Exterior fixtures.** Light fixtures attached to the walls or ceilings of a spraying area, but which are outside of any classified area and are separated from the spraying area by vapor-tight glass panels, shall be suitable for use in ordinary hazard locations. Such fixtures shall be serviced from outside the spraying area.
- 12.4.5.3 Integral fixtures.** Light fixtures that are an integral part of the walls or ceiling of a spraying area are allowed to be separated from the spraying area by glass panels that are an integral part of the fixture. Such fixtures shall be listed for use in Class I, Division 2 or Class II, Division 2 locations, whichever is applicable, and also shall be suitable for accumulations of deposits of combustible residues. Such fixtures are allowed to be serviced from inside the spraying area.
- 12.4.5.4 Portable electric lamps.** Portable electric lamps shall not be used in spraying areas during spraying operations. Portable electric lamps used during cleaning or repairing operations shall be of a type approved for hazardous locations.
- 12.4.6 Fire protection.** Spray booths and spray rooms shall be protected by an approved automatic fire-extinguishing system complying with Chapter 7 which shall also

protect exhaust plenums, exhaust ducts and both sides of dry filters when such filters are used.

- 12.4.6.1 Protection of sprinklers.** Automatic sprinklers installed in spraying areas shall be protected from accumulation of residue from spraying operations in an approved manner. Bags used as a protective covering shall be 0.076-mm-thick polyethylene or cellophane or shall be thin paper. Automatic sprinklers contaminated by overspray particles shall be replaced with new automatic sprinklers.
- 12.4.6.2 Automated spray application operations.** Where protecting automated spray application operations, automatic fire-extinguishing systems shall be equipped with an approved interlock feature that will, upon discharge of the system, automatically stop the operation of spraying operations and work piece conveyors into and out of the spraying area. Where the building is equipped with a fire alarm system, discharge of the automatic fire-extinguishing system shall also activate the building alarm notification appliances.
- 12.4.6.2.1 Alarm station.** A manual fire alarm and emergency system shutdown station shall be installed to serve each spraying area. When activated, the station shall accomplish the functions indicated in Section 12.4.6.2. At least one such station shall be readily accessible to operating personnel. Where access to this station is likely to involve exposure to danger, an additional station shall be located adjacent to an exit from the area.
- 12.4.6.3 Ventilation interlock prohibited.** Air makeup and spraying area exhaust systems shall not be interlocked with the fire alarm system and shall remain in operation during a fire alarm condition.  
**Exception:** Where the type of fire-extinguishing system used requires that ventilation be discontinued, air makeup and exhaust systems shall shut down and dampers shall close.
- 12.4.6.4 Fire extinguishers.** Portable fire extinguishers complying with Section 7.6 shall be provided for spraying areas in accordance with the requirements for an extra (high) hazard occupancy.
- 12.4.7 Drying operations.** Spray booths and spray rooms shall not be alternately used for the purpose of drying by arrangements which could cause an increase in the surface temperature of the spray booth or spray room except in accordance with Sections 12.4.7.1 through 12.4.7.2.3.
- 12.4.7.1 Spraying procedure.** The spraying procedure shall use low-volume spray application.
- 12.4.7.2 Drying apparatus.** Fixed drying apparatus shall comply with this chapter and the applicable provisions of Chapter 19. When recirculation ventilation is provided in accordance with Section 12.4.2.2, the heating system shall not be within the recirculation air path.
- 12.4.7.2.1 Interlocks.** The spraying apparatus, drying apparatus and ventilating system for the spray booth or spray room shall be equipped with interlocks arranged to:
1. Prevent operation of spraying apparatus while drying operations are in progress.
  2. Purge spray vapors from the spray booth or spray room for a period of not less than 3 minutes before drying apparatus is rendered operable.
  3. Have the ventilating system maintain a safe atmosphere within the spray booth or spray room during the drying process and automatically shutoff drying apparatus in the event of a failure of the ventilating system.
  4. Shutoff the drying apparatus automatically if the air temperature within the booth exceeds 93°C.

- 12.4.7.2.2 Portable infrared apparatus.** When portable infrared drying apparatus is used, electrical wiring and portable infrared drying equipment shall comply with the SBC 401. Electrical equipment located within 450 mm of floor level shall be approved for Class I, Division 2 hazardous locations. Metallic parts of drying apparatus shall be electrically bonded and grounded. During spraying operations, portable drying apparatus and electrical connections and wiring thereto shall not be located within spray booths, spray rooms or other areas where spray residue would be deposited thereon.
- 12.4.7.2.3 Sources of ignition.** Except as specifically provided in this section, drying or baking units utilizing a heating system having open flames or which are capable of producing sparks, shall not be installed in a spraying area.

## SECTION 12.5 DIPPING OPERATIONS

- 12.5.1 Location of dip-tank operations.** Dip-tank operations conducted in buildings used for Group A, I or R occupancies shall be located in a room designed for that purpose, equipped with an approved automatic sprinkler system, and separated vertically and horizontally from other areas in accordance with the Section 7.3.
- 12.5.2 Ventilation of vapor areas.** Vapor areas shall be provided with mechanical ventilation adequate to prevent the dangerous accumulation of vapors. Required ventilation systems shall be arranged such that the failure of any ventilating fan shall automatically stop the dipping conveyor system.
- 12.5.3 Construction of dip tanks.** Dip tanks shall be constructed in accordance with this section and NFPA 34. Dip tanks, including drain boards, shall be constructed of noncombustible material and their supports shall be of heavy metal, reinforced concrete or masonry.
- 12.5.3.1 Overflow.** Dip tanks greater than 568 L in capacity or 1.0 m<sup>2</sup> in liquid surface area shall be equipped with a trapped overflow pipe leading to an approved location outside the building. The bottom of the overflow connection shall not be less than 152 mm below the top of the tank.
- 12.5.3.2 Bottom drains.** Dip tanks greater than 1,893 L in liquid capacity shall be equipped with bottom drains that are arranged to automatically and manually drain the tank quickly in the event of a fire unless the viscosity of the liquid at normal atmospheric temperature makes this impractical. Manual operation shall be from a safe, accessible location. Where gravity flow is not practicable, automatic pumps shall be provided. Such drains shall be trapped and discharge to a closed, vented salvage tank or to an approved outside location.  
**Exception:** Dip tanks containing Class IIIB combustible liquids where the liquids are not heated above room temperature and the process area is protected by automatic sprinklers.
- 12.5.3.3 Dipping liquid temperature control.** Protection against the accumulation of vapors, self-ignition and excessively high temperatures shall be provided for dipping liquids that are heated directly or heated by the surfaces of the object being dipped.
- 12.5.4 Conveyors.** Dip tanks utilizing a conveyor system shall be arranged such that in the event of fire, the conveyor system shall automatically cease motion and the required tank bottom drains shall open.



- 12.5.5 Portable fire extinguishers.** Areas in the vicinity of dip tanks shall be provided with portable fire extinguishers complying with Section 7.6 and suitable for flammable and combustible liquid fires as specified for extra (high) hazard occupancies.
- 12.5.6 Fixed fire-extinguishing equipment.** An approved automatic fire-extinguishing system or dip tank covers in accordance with Section 12.5.7 shall be provided for the following dip tanks:
1. Dip tanks less than 568 L in capacity or 0.93 m<sup>2</sup> in liquid surface area.
  2. Dip tanks containing a liquid with a flash point below 43°C, used in such manner that the liquid temperature could equal or be greater than its flash point from artificial or natural causes, and having both a capacity of more than 37.9 L and a liquid surface area of more than 0.37 m<sup>2</sup>.
- 12.5.6.1 Fire-extinguishing system.** An approved automatic fire-extinguishing system shall be provided for dip tanks with a 568 L or more capacity, or 0.93 m<sup>2</sup> or larger in a liquid surface area. Fire-extinguishing system design shall be in accordance with NFPA 34.
- 12.5.7 Dip tank covers.** Dip tank covers allowed by Section 12.5.6 shall be capable of manual operation and shall be automatic-closing by approved automatic-closing devices designed to operate in the event of fire.
- 12.5.7.1 Construction.** Covers shall be constructed of noncombustible material or be of a tin-clad type with enclosing metal applied with locked joints.
- 12.5.7.2 Supports.** Chain or wire rope shall be utilized for cover supports or operating mechanisms.
- 12.5.7.3 Closed covers.** Covers shall be kept closed when tanks are not in use.
- 12.5.8 Hardening and tempering tanks.** Hardening and tempering tanks shall comply with Sections 12.5.3 through 12.5.5 but shall be exempt from other provisions of Section 12.5.
- 12.5.8.1 Location.** Tanks shall be located as far as practical from furnaces and shall not be located on or near combustible floors.
- 12.5.8.2 Hoods.** Tanks shall be provided with a noncombustible hood and vent or other approved venting means, terminating outside of the structure to serve as a vent in case of a fire. Such vent ducts shall be treated as flues, and proper clearances shall be maintained from combustible materials.
- 12.5.8.3 Alarms.** Tanks shall be equipped with a high-temperature limit switch arranged to sound an alarm when the temperature of the quenching medium reaches 10°C below the flash point.
- 12.5.8.4 Fire protection.** Hardening and tempering tanks greater than 1,893 L in capacity or 2.3 m<sup>2</sup> in liquid surface area shall be protected by an approved automatic fire-extinguishing system complying with Chapter 7.
- 12.5.8.5 Use of air pressure.** Air under pressure shall not be used to fill or agitate oil in tanks.
- 12.5.9 Flow-coating operations.** Flow-coating operations shall comply with the requirements for dip tanks. The area of the sump and any areas on which paint flows shall be considered to be the area of a dip tank.

- 12.5.9.1 Paint supply.** Paint shall be supplied by a gravity tank not exceeding 37.9 L in capacity or by direct low-pressure pumps arranged to shut down automatically in case of fire by means of approved heat-actuated devices.
- 12.5.10 Roll-coating operations.** Roll-coating operations shall comply with Section 12.5.9. In roll-coating operations utilizing flammable or combustible liquids, sparks from static electricity shall be prevented by electrically bonding and grounding all metallic rotating and other parts of machinery and equipment and by the installation of static collectors or by maintaining a conductive atmosphere such as a high relative humidity.

## SECTION 12.6 ELECTROSTATIC APPARATUS

- 12.6.1 General.** Electrostatic apparatus and devices used in connection with paint-spraying and paint-deteared operations shall be of an approved type.
- 12.6.2 Location.** Transformers, power packs, control apparatus and all other electrical portions of the equipment, except high-voltage grids and electrostatic atomizing heads and connections, shall be located outside of the spraying or vapor areas, or shall comply with Section 12.3.2.
- 12.6.3 Construction of equipment.** Electrodes and electrostatic atomizing heads shall be of approved construction, rigidly supported in permanent locations and effectively insulated from ground. Insulators shall be nonporous and noncombustible.
- 12.6.4 Clear space.** A space of at least twice the sparking distance shall be maintained between goods being painted or deteared and electrodes, electrostatic atomizing heads or conductors. A sign stating the sparking distance shall be conspicuously posted near the assembly.
- 12.6.5 Emergency shutdown.** Electrostatic apparatus shall be equipped with automatic controls operating without time delay to disconnect the power supply to the high-voltage transformer and signal the operator under any of the following conditions:
1. Stoppage of ventilating fans or failure of ventilating equipment from any cause.
  2. Stoppage of the conveyor carrying articles past the high-voltage grid.
  3. Occurrence of a ground or an imminent ground at any point of the high-voltage system.
  4. Reduction of clearance below that required in Section 12.6.4.
- 12.6.6 Ventilation interlock.** Hand electrostatic equipment shall be interlocked with the ventilation system for the spraying area so that the equipment cannot be operated unless the ventilating system is in operation.
- 12.6.7 Protection for automated liquid electrostatic spray application equipment.** Automated liquid electrostatic spray application equipment shall be protected by the installation of an approved, supervised flame detection apparatus that shall, in the event of ignition, react to the presence of flame within 0.5 second and shall accomplish all of the following:
1. Activation of a local alarm in the vicinity of the spraying operation and activation of the building alarm system, if such system is provided.

2. Shutting down of the coating material delivery system.
3. Termination of all spray application operations.
4. Stopping of conveyors into and out of the spraying area.
5. Disconnection of power to the high-voltage elements in the spraying area and disconnection of power to the system.

- 12.6.8 Barriers.** Booths, fencing, railings or guards shall be placed about the equipment such that either by their location or character, or both, isolation of the process is maintained from plant storage and personnel. Railings, fencing and guards shall be of conductive material, adequately grounded, and shall be at least 1.5 m from processing equipment.
- 12.6.9 Signs.** Signs shall be posted to provide the following information:
1. Designate the process zone as dangerous with respect to fire and accident.
  2. Identify the grounding requirements for all electrically conductive objects in the spray area, including persons.
  3. Restrict access to qualified personnel only.
- 12.6.10 Ventilation.** The spraying area shall be ventilated in accordance with Section 12.4.2.
- 12.6.11 Maintenance.** Insulators shall be kept clean and dry. Drip plates and screens subject to paint deposits shall be removable and taken to a safe place for cleaning.
- 12.6.12 Fire protection.** Areas used for electrostatic spray finishing with fixed equipment shall be protected with an approved automatic fire-extinguishing system complying with Chapter 7.

## SECTION 12.7 POWDER COATING

- 12.7.1 General.** Operations using finely ground particles of protective finishing material applied in dry powder form by fluidized bed, electrostatic fluidized bed, powder spray guns or electrostatic powder spray guns shall comply with this section.
- 12.7.2 Location and construction of powder coating rooms and booths.** Powder coating operations shall be conducted in enclosed rooms constructed of noncombustible materials, enclosed powder coating facilities which are ventilated, or ventilated spray booths complying with Section 12.4.1.2.  
**Exception:** Listed spray-booth assemblies that are constructed of other materials shall be allowed.
- 12.7.3 Sources of ignition.** When parts are heated prior to coating, the temperature of the parts shall not exceed the ignition temperature of the powder to be used. Precautions shall be taken to minimize the possibility of ignition by static electrical sparks through static bonding and grounding, where possible, of powder transport, application and recovery equipment.
- 12.7.4 Ventilation.** Exhaust ventilation shall be sufficient to maintain the atmosphere below one-half the minimum explosive concentration for the material being applied. Non-deposited, air-suspended powders shall be removed through exhaust ducts to the powder recovery system.

- 12.7.5 Drying, curing and fusion equipment.** Drying, curing and fusion equipment shall comply with Chapter 19.
- 12.7.6 Operation and maintenance.** Powder coating areas shall be kept free from the accumulation of powder coating dusts, including horizontal surfaces such as ledges, beams, pipes, hoods, booths and floors.
- 12.7.6.1 Cleaning.** Surfaces shall be cleaned in such a manner so as to avoid scattering dusts to other places or creating dust clouds. Vacuum sweeping equipment shall be of a type approved for use in hazardous location.
- 12.7.6.2 Spark-producing metals.** Iron or spark-producing metals shall be prevented from being introduced into the powders being applied by magnetic separators, filter-type separators, or by other approved means.
- 12.7.6.3 Smoking.** “No Smoking” signs complying with Chapter 15 of the SBC 201 shall be conspicuously posted at all powder coating areas and powder storage rooms.
- 12.7.7 Fixed electrostatic-spraying equipment.** In addition to Section 12.7, Section 12.6 shall apply to fixed electrostatic equipment used in powder coating operations.
- 12.7.8 Fire protection.** Areas used for powder coating shall be protected by an approved automatic fire-extinguishing system complying with Chapter 7.
- 12.7.9 Additional protection for fixed systems.** Automated powder application equipment shall be protected by the installation of an approved, supervised flame detection apparatus that shall react to the presence of flame within 0.5 second and shall accomplish all of the following:
1. Shutting down of energy supplies (electrical and compressed air) to conveyor, ventilation, application, transfer and powder collection equipment.
  2. Closing of segregation dampers in associated ductwork to interrupt airflows from application equipment to powder collectors.
  3. Activation of an alarm that is audible throughout the powder coating room or booth.
- 12.7.10 Fire extinguishers.** Portable fire extinguishers complying with Section 7.6 shall be provided for areas used for powder coating in accordance with the requirements for extra hazard occupancy.

## SECTION 12.8 AUTOMOBILE UNDERCOATING

- 12.8.1 General.** Automobile undercoating spray operations conducted in areas with approved natural or mechanical ventilation shall be exempt from the provisions of Section 12.4 when approved and where utilizing Class IIIA or IIIB combustible liquids.

## SECTION 12.9 ORGANIC PEROXIDES AND DUAL-COMPONENT COATINGS

- 12.9.1 Contamination prevention.** Organic peroxide initiators shall not be contaminated with foreign substances.

- 12.9.2 Equipment.** Spray guns and related handling equipment used with organic peroxides shall be of a type manufactured for such use.
- 12.9.3 Pressure tanks.** Separate pressure vessels and inserts specifically for the application shall be used for the resin and for the organic peroxide, and shall not be interchanged. Organic peroxide pressure tank inserts shall be constructed of stainless steel or polyethylene.
- 12.9.4 Residue control.** Materials shall not be contaminated by dusts and overspray residues resulting from the sanding or spraying of finishing materials containing organic peroxides.
- 12.9.5 Spilled material.** Spilled organic peroxides shall be promptly removed so there are no residues. Spilled material absorbed by using a noncombustible absorbent shall be promptly disposed of in accordance with the manufacturer's recommendation.
- 12.9.6 Use of organic peroxide coatings.** Spraying operations involving the use of organic peroxides and other dual-component coatings shall be conducted in approved sprinklered spray booths complying with Section 12.4.1.2.
- 12.9.7 Storage.** The storage of organic peroxides shall comply with Chapter 37.
- 12.9.8 Handling.** Handling of organic peroxides shall be conducted in a manner that avoids shock and friction that produces decomposition and violent reaction hazards.
- 12.9.9 Mixing.** Organic peroxides shall not be mixed directly with accelerators or promoters.
- 12.9.10 Sources of ignition.** Smoking shall be prohibited and "No Smoking" signs complying with Chapter 15 of the SBC 201 shall be prominently displayed. Only non-sparking tools shall be used in areas where organic peroxides are stored, mixed or applied.
- 12.9.11 Personnel qualifications.** Personnel working with organic peroxides and dual-component coatings shall be specifically trained to work with these materials.

## SECTION 12.10 FLOOR SURFACING AND FINISHING OPERATIONS

- 12.10.1 Scope.** Floor surfacing and finishing operations exceeding 33 m<sup>2</sup> and using Class I or Class II liquids shall comply with Sections 12.10.2 through 12.10.5.
- 12.10.2 Business operation.** Floor surfacing and finishing operations shall not be conducted while an establishment is open to the public.
- 12.10.3 Ventilation.** To prevent the accumulation of flammable vapors, mechanical ventilation at a minimum rate of 0.00508 m<sup>3</sup>/(s · m<sup>2</sup>) of area being finished shall be provided. Such exhaust shall be by approved temporary or portable means. Vapors shall be exhausted to the exterior of the building.

- 12.10.4 Mechanical system operation.** Heating, ventilation and air-conditioning systems shall not be operated during resurfacing or refinishing operations or within 4 hours of the application of flammable or combustible liquids.
- 12.10.5 Ignition sources.** The power to all electrical devices shall be shut down to all electrical sources of ignition within the vapor area, unless those devices are classified for use in Class I, Division 1 hazardous locations.

## SECTION 12.11 INDOOR MANUFACTURING OF REINFORCED PLASTICS

- 12.11.1 General.** Indoor manufacturing processes involving spray or hand application of reinforced plastics and using more than 19 L of resin in a 24-hour period shall be in accordance with this section.
- 12.11.2 Resin application equipment.** Equipment used for spray application of resin shall be installed and used in accordance with Sections 12.9 and 12.11.
- 12.11.3 Fire protection.** Resin application areas shall be protected by an automatic sprinkler system. The sprinkler system design shall not be less than that required for Ordinary Hazard, Group 2, with a minimum design area of 279 m<sup>2</sup>. Where the materials or storage arrangements are required by other regulations to be provided with a higher level of sprinkler system protection, the higher level of sprinkler system protection shall be provided.
- 12.11.4 Sources of ignition in resin application areas.** Sources of ignition in resin application areas shall comply with Section 12.3.2.
- 12.11.5 Ventilation.** Mechanical ventilation shall be provided throughout resin application areas in accordance with Sections 12.4.2 and 12.4.3. The ventilation rate shall be adequate to maintain the concentration of flammable vapors in the resin application area at or below 25 percent of the lower flammable limit (LFL).  
**Exception:** Mechanical ventilation is not required for buildings that are unenclosed for at least 75 percent of the perimeter.
- 12.11.5.1 Local ventilation.** Local ventilation shall be provided inside of work pieces where personnel will be under or inside of the work piece.
- 12.11.6 Storage and use of hazardous materials.** Storage and use of organic peroxides shall be in accordance with Section 12.9 and Chapter 37. Storage and use of flammable and combustible liquids shall be in accordance with Chapter 32. Storage and use of unstable (reactive) materials shall be in accordance with Chapter 41.
- 12.11.7 Handling of excess catalyzed resin.** A noncombustible, open-top container shall be provided for disposal of excess catalyzed resin. Excess catalyzed resin shall be drained into the container while still in the liquid state. Enough water shall be provided in the container to maintain a minimum 50 mm water layer over contained resin.
- 12.11.8 Control of overchop.** In areas where chopper guns are used, exposed wall and floor surfaces shall be covered with paper, polyethylene film, or other approved

material to allow for removal of overchop. Overchop shall be allowed to cure for not less than 4 hours prior to removal.

- 12.11.8.1 Disposal.** Following removal, used wall and floor covering materials required by Section 12.11.8 shall be placed in a noncombustible container and removed from the facility.

## **SECTION 12.12 COMBUSTIBLE DUST-PRODUCING OPERATIONS**

### **SECTION 12.12.1 GENERAL**

- 12.12.1.1 Scope.** The equipment, processes and operations involving dust explosion hazards shall comply with the provisions of this section.
- 12.12.1.2 Permits.** Permits shall be required for combustible dust-producing operations as set forth in SBC 100.

### **SECTION 12.12.2 DEFINITIONS**

- 12.12.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**COMBUSTIBLE DUST.** Finely divided solid material which is 420 microns or less in diameter and which, when dispersed in air in the proper proportions, could be ignited by a flame, spark or other source of ignition. Combustible dust will pass through No. 40 standard sieve.

### **SECTION 12.12.3 PRECAUTIONS**

- 12.12.3.1 Sources of ignition.** Smoking or the use of heating or other devices employing an open flame, or the use of spark-producing equipment is prohibited in areas where combustible dust is generated, stored, manufactured, processed or handled.
- 12.12.3.2 Housekeeping.** Accumulation of combustible dust shall be kept to a minimum in the interior of buildings. Accumulated combustible dust shall be collected by vacuum cleaning or other means that will not place combustible dust into suspension in air. Forced air or similar methods shall not be used to remove dust from surfaces.

### **SECTION 12.12.4 EXPLOSION PROTECTION**

- 12.12.4.1 Standards.** The building code official is authorized to enforce applicable provisions of the codes and standards listed in Table 12.12.4.1 to prevent and control dust explosions.

**TABLE 12.12.4.1**  
**EXPLOSION PROTECTION STANDARDS**

<b>STANDARD</b>	<b>SUBJECT</b>
NFPA 61	Agriculture and Food Products
NFPA 69	Explosion Prevention
NFPA 85	Boiler and Combustion Systems Hazards
NFPA 120	Coal Preparation Plants
NFPA 480	Magnesium Solids and Powders
NFPA 481	Titanium
NFPA 482	Zirconium
NFPA 650	Conveying Combustible Particulate Solids
NFPA 651	Aluminum Powder
NFPA 654	Chemical, Dye, Pharmaceutical and Plastics
NFPA 655	Sulfur
NFPA 664	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities
SBC 401	Electrical Installations



## CHAPTER 13 DRY CLEANING

### SECTION 13.1 GENERAL

- 13.1.1 Scope.** Dry cleaning plants and their operations shall comply with the requirements of this chapter.
- 13.1.2 Permit required.** Permits shall be required as set forth in SBC 100.

### SECTION 13.2 DEFINITIONS

- 13.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**DRY CLEANING.** The process of removing dirt, grease, paints and other stains from such items as wearing apparel, textiles, fabrics and rugs by use of nonaqueous liquids (solvents).

**DRY CLEANING PLANT.** A facility in which dry cleaning and associated operations are conducted, including the office, receiving area and storage rooms.

**DRY CLEANING ROOM.** An occupiable space within a building used for performing dry cleaning operations, the installation of solvent-handling equipment or the storage of dry cleaning solvents.

**DRY CLEANING SYSTEM.** Machinery or equipment in which textiles are immersed or agitated in solvent or in which dry cleaning solvent is extracted from textiles.

**SOLVENT OR LIQUID CLASSIFICATIONS.** A method for classifying solvents or liquids according to the following classes:

**Class I solvents.** Liquids having a flash point below 38°C.

**Class II solvents.** Liquids having a flash point at or above 38°C and below 60°C.

**Class IIIA solvents.** Liquids having a flash point at or above 60°C and below 93°C.

**Class IIIB solvents.** Liquids having a flash point at or above 93°C.

**Class IV solvents.** Liquids classified as nonflammable.

### SECTION 13.3 CLASSIFICATIONS

- 13.3.1 Solvent classification.** Dry cleaning solvents shall be classified according to their flash points as follows:
- 1.** Class I solvents are liquids having a flash point below 38°C.
  - 2.** Class II solvents are liquids having a flash point at or above 38°C and below 60°C.

3. Class IIIA solvents are liquids having a flash point at or above 60°C and below 93°C.
4. Class IIIB solvents are liquids having a flash point at or above 93°C.
5. Class IV solvents are liquids classified as nonflammable.

**13.3.2 Classification of dry cleaning plants and systems.** Dry cleaning plants and systems shall be classified based on the solvents used as follows:

1. Type I – systems using Class I solvents.
2. Type II – systems using Class II solvents.
3. Type III-A – systems using Class IIIA solvents.
4. Type III-B – systems using Class IIIB solvents.
5. Type IV – systems using Class IV solvents in which dry cleaning is not conducted by the public.
6. Type V – systems using Class IV solvents in which dry cleaning is conducted by the public.

Spotting and pretreating operations conducted in accordance with Section 13.6 shall not change the type of the dry cleaning plant.

**13.3.2.1 Multiple solvents.** Dry cleaning plants using more than one class of solvent for dry cleaning shall be classified based on the numerically lowest solvent class.

**13.3.3 Design.** The occupancy classification, design and construction of dry cleaning plants shall comply with the applicable requirements of the SBC 100.

## SECTION 13.4 GENERAL REQUIREMENTS

**13.4.1 Prohibited use.** Type I dry cleaning plants shall be prohibited. Limited quantities of Class I solvents stored and used in accordance with this section shall not be prohibited in dry cleaning plants.

**13.4.2 Building services.** Building services and systems shall be designed, installed and maintained in accordance with this section and Chapter 5.

**13.4.2.1 Ventilation.** Ventilation shall be provided in accordance with the SBC 501.

**13.4.2.2 Heating.** In Type II dry cleaning plants, heating shall be by indirect means using steam, hot water, or hot oil only.

**13.4.2.3 Electrical wiring and equipment.** Electrical wiring and equipment in dry cleaning rooms or other locations subject to flammable vapors shall be installed in accordance with the SBC 401.

**13.4.2.4 Bonding and grounding.** Storage tanks, treatment tanks, filters, pumps, piping, ducts, dry cleaning units, stills, tumblers, drying cabinets and other such equipment, where not inherently electrically conductive, shall be bonded together and grounded. Isolated equipment shall be grounded.

## SECTION 13.5 OPERATING REQUIREMENTS

**13.5.1 General.** The operation of dry cleaning systems shall comply with the requirements of this section.

**13.5.1.1 Written instructions.** Written instructions covering the proper installation and safe operation and use of equipment and solvent shall be given to the buyer.

**13.5.1.1.1 Type II, III-A, III-B and IV systems.** In Type II, III-A, III-B and IV dry cleaning systems, machines shall be operated in accordance with the operating instructions

furnished by the machinery manufacturer. Employees shall be instructed as to the hazards involved in their departments and in the work they perform.

- 13.5.1.1.2 **Type V systems.** Operating instructions for customer use of Type V dry cleaning systems shall be conspicuously posted in a location near the dry cleaning unit. A telephone number shall be provided for emergency assistance.
- 13.5.1.2 **Equipment identification.** The manufacturer shall provide nameplates on dry cleaning machines indicating the class of solvent for which each machine is designed.
- 13.5.1.3 **Open systems prohibited.** Dry cleaning by immersion and agitation in open vessels shall be prohibited.
- 13.5.1.4 **Prohibited use of solvent.** The use of solvents with a flash point below that for which a machine is designed or listed shall be prohibited.
- 13.5.1.5 **Equipment maintenance and housekeeping.** Proper maintenance and operating practices shall be observed in order to prevent the leakage of solvent or the accumulation of lint. The handling of waste material generated by dry cleaning operations and the maintenance of facilities shall comply with the provisions of this section.
  - 13.5.1.5.1 **Floors.** Class I and II liquids shall not be used for cleaning floors.
  - 13.5.1.5.2 **Filters.** Filter residue and other residues containing solvent shall be handled and disposed of in covered metal containers.
  - 13.5.1.5.3 **Lint.** Lint and refuse shall be removed from traps daily, deposited in approved waste cans, removed from the premises, and disposed of safely. At all other times, traps shall be held securely in place.
  - 13.5.1.5.4 **Customer areas.** In Type V dry cleaning systems, customer areas shall be kept clean.
- 13.5.2 **Type II systems.** Special operating requirements for Type II dry cleaning systems shall comply with the provisions of this section.
  - 13.5.2.1 **Inspection of materials.** Materials to be dry cleaned shall be searched thoroughly and foreign materials, including matches and metallic substances, shall be removed.
  - 13.5.2.2 **Material transfer.** In removing materials from the washer, provisions shall be made for minimizing the dripping of solvent on the floor. Where materials are transferred from a washer to a drain tub, a nonferrous metal drip apron shall be placed so that the apron rests on the drain tub and the cylinder of the washer.
  - 13.5.2.3 **Ventilation.** A mechanical ventilation system which is designed to exhaust  $0.00508 \text{ m}^3/\text{s}\cdot\text{m}^2$  shall be installed in dry cleaning rooms and in drying rooms. The ventilation system shall operate automatically when the dry cleaning equipment is in operation and shall have manual controls at an approved location.
- 13.5.3 **Type IV and V systems.** Type IV and V dry cleaning systems shall be provided with an automatically activated exhaust ventilation system to maintain a minimum of  $0.51 \text{ m/s}$  air velocity through the loading door when the door is opened. Such systems for dry cleaning equipment shall comply with the SBC 501.
 

**Exception:** Dry cleaning units are not required to be provided with exhaust ventilation where an exhaust hood is installed immediately outside of and above the loading door which operates at an airflow rate as follows:

$$Q = 547 \times A_{LD} \quad (\text{Equation 13.1})$$

where:

$Q$  = Flow rate exhausted through the hood, L/s.

$A_{LD}$  = Area of the loading door,  $\text{m}^2$ .

## SECTION 13.6 SPOTTING AND PRETREATING

- 13.6.1 General.** Spotting and pretreating operations and equipment shall comply with the provisions of this section.
- 13.6.2 Type I solvents.** The maximum quantity of Type I solvents permitted at any work station shall be 4 L. Class I solvents shall be stored in approved safety cans or in sealed DOTn-approved metal shipping containers of not more than 4 L capacity. Dispensing shall be from approved safety cans.
- 13.6.3 Type II and III solvents.** Scouring, brushing, and spotting and pretreating shall be conducted with Class II or III solvents. The maximum quantity of Type II or III solvents permitted at any work station shall be 4 L. In other than a Group H-2 occupancy, the aggregate quantities of solvents shall not exceed the maximum allowable quantity per control area for use-open system.
- 13.6.3.1 Spotting tables.** Scouring, brushing or spotting tables on which articles are soaked in solvent shall have a liquid-tight top with a curb on all sides not less than 25 mm high. The top of the table shall be pitched to ensure thorough draining to a 38 mm drain connected to an approved container.
- 13.6.3.2 Special handling.** When approved, articles that cannot be washed in the usual washing machines are allowed to be cleaned in scrubbing tubs. Scrubbing tubs shall comply with the following:
- 1.** Only Class II or III liquids shall be used.
  - 2.** The total amount of solvent used in such open containers shall not exceed 11 L.
  - 3.** Scrubbing tubs shall be secured to the floor.
  - 4.** Scrubbing tubs shall be provided with permanent 38 mm drains. Such drain shall be provided with a trap and shall be connected to an approved container.
- 13.6.3.3 Ventilation.** Scrubbing tubs, scouring, brushing or spotting operations shall be located such that solvent vapors are captured and exhausted by the ventilating system.
- 13.6.3.4 Bonding and grounding.** Metal scouring, brushing and spotting tables and scrubbing tubs shall be permanently and effectively bonded and grounded.
- 13.6.4 Type IV systems.** Flammable and combustible liquids used for spotting operations shall be stored in approved safety cans or in sealed MOT-approved metal shipping containers of not more than 4 L in capacity. Dispensing shall be from approved safety cans. Aggregate amounts shall not exceed 38 L.
- 13.6.5 Type V systems.** Spotting operations using flammable or combustible liquids are prohibited in Type V dry cleaning systems.

## SECTION 13.7 DRY CLEANING SYSTEMS

- 13.7.1 General equipment requirements.** Dry cleaning systems, including dry cleaning units, washing machines, stills, drying cabinets, tumblers, and their appurtenances, including pumps, piping, valves, filters and solvent coolers, shall be installed and maintained in accordance with NFPA 32. The construction of buildings in which such systems are located shall comply with the requirements of this section and the SBC 201-B:C portable fire extinguishers shall be provided near the doors inside

dry cleaning rooms containing Type II, Type III-A and Type III-B dry cleaning systems.

- 13.7.2 Type II systems.** Type II dry cleaning and solvent tank storage rooms shall not be located below grade or above the lowest floor level of the building and shall comply with Sections 13.7.2.1 through 13.7.2.3.  
**Exception:** Solvent storage tanks installed underground, in vaults or in special enclosures in accordance with Chapter 32.
- 13.7.2.1 Fire-fighting access.** Type II dry cleaning plants shall be located so that access is provided and maintained from one side for fire-fighting and fire control purposes in accordance with Chapter 5.
- 13.7.2.2 Number of means of egress.** Type II dry cleaning rooms shall have not less than two means of egress doors located at opposite ends of the room, at least one of which shall lead directly to the outside.
- 13.7.2.3 Spill control and secondary containment.** Curbs, drains, or other provisions for spill control and secondary containment shall be provided in accordance with Section 25.4.2 to collect solvent leakage and fire protection water and direct it to a safe location.
- 13.7.3 Solvent storage tanks.** Solvent storage tanks for Class II, IIIA and IIIB liquids shall conform to the requirements of Chapter 32 and be located underground or outside, above ground.  
**Exception:** As provided in NFPA 32 for inside storage or treatment tanks.

## SECTION 13.8 FIRE PROTECTION

- 13.8.1 General.** Where required by this section, fire protection systems, devices and equipment shall be installed, inspected, tested and maintained in accordance with Chapter 7.
- 13.8.2 Automatic sprinkler system.** An automatic sprinkler system shall be installed in accordance with Section 7.3 throughout dry cleaning plants containing Type II, Type III-A or Type III-B dry cleaning systems.
- 13.8.3 Automatic fire-extinguishing systems.** Type II dry cleaning units, washer-extractors, and drying tumblers in Type II dry cleaning plants shall be provided with an approved automatic fire-extinguishing system installed and maintained in accordance with Chapter 7.  
**Exception:** Where approved, a manual steam jet not less than 19 mm with a continuously available steam supply at a pressure not less than 103 kPa is allowed to be substituted for the automatic fire-extinguishing system.
- 13.8.4 Portable fire extinguishers.** Portable fire extinguishers shall be selected, installed and maintained in accordance with this section and Section 7.6. A minimum of two 2-A:10-B:C portable fire extinguishers shall be provided near the doors inside dry cleaning rooms containing Type II, Type III-A and Type III-B dry cleaning systems.

## CHAPTER 14 FRUIT AND CROP RIPENING

### SECTION 14.1 GENERAL

- 14.1.1 Scope.** Ripening processes where ethylene gas is introduced into a room to promote the ripening of fruits, vegetables and other crops shall comply with this chapter.  
**Exception:** Mixtures of ethylene and one or more inert gases in concentrations which prevent the gas from reaching greater than 25 percent of the lower explosive limit (LEL) when released to the atmosphere.
- 14.1.2 Permits.** Permits shall be required as set forth in SBC 100.
- 14.1.3 Ethylene generators.** Approved ethylene generators shall be operated and maintained in accordance with Section 14.6.

### SECTION 14.2 DEFINITIONS

- 14.2.1 Terms defined in Chapter 1.** Words and terms used in this chapter and defined in Chapter 1 shall have the meanings ascribed to them as defined therein.

### SECTION 14.3 ETHYLENE GAS

- 14.3.1 Location.** Ethylene gas shall be discharged only into approved rooms or enclosures designed and constructed for this purpose.
- 14.3.2 Dispensing.** Valves controlling discharge of ethylene shall provide positive and fail-closed control of flow and shall be set to limit the concentration of gas in air below 1,000 parts per million (ppm).

### SECTION 14.4 SOURCES OF IGNITION

- 14.4.1 Ignition prevention.** Sources of ignition shall be controlled or protected in accordance with this section and Chapter 5.
- 14.4.2 Electrical wiring and equipment.** Electrical wiring and equipment, including lighting fixtures, shall be approved for use in Class I, Division 2, Group C hazardous (classified) locations.
- 14.4.3 Static electricity.** Containers, piping and equipment used to dispense ethylene shall be bonded and grounded to prevent the discharge of static sparks or arcs.
- 14.4.4 Lighting.** Lighting shall be by approved electric lamps or fixtures only.
- 14.4.5 Heating.** Heating shall be by indirect means utilizing low-pressure steam, hot water, or warm air.

**Exception:** Electric or fuel-fired heaters approved for use in hazardous (classified) locations which are installed and operated in accordance with the applicable provisions of the SBC 401, and the SBC 501.

#### **SECTION 14.5 COMBUSTIBLE WASTE**

- 14.5.1 Housekeeping.** Empty boxes, cartons, pallets and other combustible waste shall be removed from ripening rooms or enclosures and disposed of at regular intervals in accordance with Chapter 5.

#### **SECTION 14.6 ETHYLENE GENERATORS**

- 14.6.1 Ethylene generators.** Ethylene generators shall be listed and labeled by an approved testing laboratory, approved by the Building code official and used only in approved rooms in accordance with the ethylene generator manufacturer's instructions. The listing evaluation shall include documentation that the concentration of ethylene gas does not exceed 25 percent of the lower explosive limit (LEL).
- 14.6.2 Ethylene generator rooms.** Ethylene generators shall be used in rooms having a volume of not less than 28 m<sup>3</sup>. Rooms shall have air circulation to ensure even distribution of ethylene gas and shall be free from sparks, open flames or other ignition sources.

#### **SECTION 14.7 WARNING SIGNS**

- 14.7.1 When required.** Approved warning signs indicating the danger involved and necessary precautions shall be posted on all doors and entrances to the premises.

## CHAPTER 15 FUMIGATION AND THERMAL INSECTICIDAL FOGGING

### SECTION 15.1 GENERAL

- 15.1.1 Scope.** Fumigation and thermal insecticidal fogging operations within structures shall comply with this chapter.
- 15.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 15.2 DEFINITIONS

- 15.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**FUMIGANT.** A substance which by itself or in combination with any other substance emits or liberates a gas, fume or vapor utilized for the destruction or control of insects, fungi, vermin, germs, rats or other pests, and shall be distinguished from insecticides and disinfectants which are essentially effective in the solid or liquid phases. Examples are methyl bromide, ethylene dibromide, hydrogen cyanide, carbon disulfide and sulfuryl fluoride.

**FUMIGATION.** The utilization within an enclosed space of a fumigant in concentrations that are hazardous or acutely toxic to humans.

**THERMAL INSECTICIDAL FOGGING.** The utilization of insecticidal liquids passed through thermal fog-generating units where, by means of heat, pressure and turbulence, such liquids are transformed and discharged in the form of fog or mist blown into an area to be treated.

### SECTION 15.3 FIRE SAFETY REQUIREMENTS

- 15.3.1 General.** Structures in which fumigation and thermal insecticidal fogging operations are conducted shall comply with the fire protection and safety requirements of Sections 15.3.2 through 15.3.7.
- 15.3.2 Sources of ignition.** Fires, open flames and similar sources of ignition shall be eliminated from the space under fumigation or thermal insecticidal fogging. Heating, where needed, shall be of an approved type.
- 15.3.2.1 Electricity.** Electricity shall be shutoff.  
**Exception:** Circulating fans that have been specifically designed for utilization in hazardous atmospheres and installed in accordance with the SBC 401.
- 15.3.3 Notification.** The building code official shall be notified in writing at least 24 hours before the structure is to be closed in connection with the utilization of any toxic or flammable fumigant. Notification shall give the location of the enclosed space to be fumigated or fogged, the occupancy, the fumigants or insecticides to be utilized, the person or persons responsible for the operation, and the date and time at which the operation will begin. Notice of any fumigation or thermal



insecticidal fogging shall be served with sufficient advance notice to the occupants of the enclosed space involved to enable the occupants to evacuate the premises.

- 15.3.3.1 Warning signs.** Approved warning signs indicating the danger, type of chemical involved and necessary precautions shall be posted on all doors and entrances to the premises and upon all gangplanks and ladders from the deck, pier or land to the ship. Such notices shall be printed in red ink on a white background. Letters in the headlines shall be at least 51 mm in height and shall state the date and time of the operation, the name and address of the person, the name of the operator in charge, and a warning stating that the occupied premises shall be vacated at least 1 hour before the operation begins and shall not be reentered until the danger signs have been removed by the proper authorities.
- 15.3.3.2 Breathing apparatus.** Persons engaged in the business of fumigation or thermal insecticidal fogging shall maintain and have available approved protective breathing apparatus.
- 15.3.3.3 Watch personnel.** During the period fumigation is in progress, except when fumigation is conducted in a gas-tight vault or tank, a capable, alert watcher shall remain on duty at the entrance or entrances to the enclosed fumigated space until after the fumigation is completed and the premises properly ventilated and safe for occupancy. Sufficient watchers shall be provided to prevent persons from entering the enclosed space under fumigation without being observed.
- 15.3.4 Thermal insecticidal fogging liquids.** Thermal insecticidal fogging liquids with a flash point below 38°C shall not be utilized.
- 15.3.5 Sealing of buildings.** Paper and other similar materials that are not flame resistant shall not be used to wrap or cover a building in excess of that required for the sealing of cracks, casements and similar openings.
- 15.3.6 Venting and cleanup.** At the end of the exposure period, fumigators shall safely and properly ventilate the premises and contents; properly dispose of fumigant containers, residues, debris and other materials used for such fumigation; and clear obstructions from gas-fired appliance vents.
- 15.3.7 Flammable fumigants restricted.** The use of carbon disulfide and hydrogen cyanide shall be restricted to agricultural fumigation.

## CHAPTER 16 SEMICONDUCTOR FABRICATION FACILITIES

### SECTION 16.1 GENERAL

- 16.1.1 Scope.** Semiconductor fabrication facilities and comparable research and development areas classified as Group H-5 shall comply with this chapter and the SBC 201. The use, storage and handling of hazardous materials in Group H-5 shall comply with this chapter, other applicable provisions of these code requirements and the SBC 201.
- 16.1.2 Application.** The requirements set forth in this chapter are requirements specific only to Group H-5 and shall be applied as exceptions or additions to applicable requirements set forth elsewhere in these code requirements.
- 16.1.3 Multiple hazards.** Where a material poses multiple hazards, all hazards shall be addressed in accordance with Section 25.1.1.
- 16.1.4 Existing buildings and existing fabrication areas.** Existing buildings and existing fabrication areas shall comply with this chapter, except that transportation and handling of HPM in exit access corridors and exit enclosures shall be allowed when in compliance with Section 16.5.3.2 and the SBC 201.
- 16.1.5 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 16.2 DEFINITIONS

- 16.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**CONTINUOUS GAS DETECTION SYSTEM.** A gas detection system where the analytical instrument is maintained in continuous operation and sampling is performed without interruption. Analysis is allowed to be performed on a cyclical basis at intervals not to exceed 30 minutes.

**EMERGENCY CONTROL STATION.** An approved location on the premises where signals from emergency equipment are received and which is staffed by trained personnel.

**FABRICATION AREA.** An area within a semiconductor fabrication facility and related research and development areas in which there are processes using hazardous production materials. Such areas are allowed to include ancillary rooms or areas such as dressing rooms and offices that are directly related to the fabrication area processes.

**HAZARDOUS PRODUCTION MATERIAL (HPM).** A solid, liquid or gas associated with semiconductor manufacturing that has a degree-of-hazard rating in health, flammability or reactivity of Class 3 or 4 as ranked by NFPA 704 and

which is used directly in research, laboratory or production processes which have as their end product materials that are not hazardous.

**HPM FLAMMABLE LIQUID.** An HPM liquid that is defined as either a Class I flammable liquid or a Class II or Class IIIA combustible liquid.

**HPM ROOM.** A room used in conjunction with or serving a Group H-5 occupancy, where HPM is stored or used and which is classified as a Group H-2, H-3 or H-4 occupancy.

**PASS-THROUGH.** An enclosure installed in a wall with a door on each side that allows chemicals, HPM, equipment, and parts to be transferred from one side of the wall to the other.

**SEMICONDUCTOR FABRICATION FACILITY.** A building or a portion of a building in which electrical circuits or devices are created on solid crystalline substances having electrical conductivity greater than insulators but less than conductors. These circuits or devices are commonly known as semiconductors.

**SERVICE CORRIDOR.** A fully enclosed passage used for transporting HPM and purposes other than required means of egress.

**TOOL.** A device, storage container, workstation, or process machine used in a fabrication area.

**WORKSTATION.** A defined space or an independent principal piece of equipment using HPM within a fabrication area where a specific function, laboratory procedure or research activity occurs. Approved or listed hazardous materials storage cabinets, flammable liquid storage cabinets or gas cabinets serving a workstation are included as part of the workstation. A workstation is allowed to contain ventilation equipment, fire protection devices, detection devices, electrical devices and other processing and scientific equipment.

### SECTION 16.3 GENERAL SAFETY PROVISIONS

- 16.3.1 Emergency control station.** An emergency control station shall be provided on the premises at an approved location outside of the fabrication area, and shall be continuously staffed by trained personnel. The emergency control station shall receive signals from emergency equipment and alarm and detection systems. Such emergency equipment and alarm and detection systems shall include, but not be limited to, the following where such equipment or systems are required to be provided either in this chapter or elsewhere in the code requirements:
1. Automatic sprinkler system alarm and monitoring systems.
  2. Manual fire alarm systems.
  3. Emergency alarm systems.
  4. Continuous-gas detection systems.
  5. Smoke detection systems.
  6. Emergency power system.

- 16.3.2 Systems, equipment and processes.** Systems, equipment and processes including, but not limited to, containers, cylinders, tanks, piping, tubing, valves and fittings and shall comply with this section, Section 25.3.2, other applicable provisions of these code requirements, the SBC 201 and the SBC 501.
- 16.3.2.1 Additional regulations for HPM supply piping and tubing.** The requirements set forth in Section 25.3.2.2.2 shall apply to supply piping and tubing for HPM gases and liquids. Supply piping and tubing for HPM gases and liquids having a health-hazard ranking of 3 or 4 shall be welded throughout, except for connections located within a ventilated enclosure if the material is a gas, or an approved method of drainage or containment is provided for connections if the material is a liquid.
- 16.3.3 Construction requirements.** Construction of semiconductor fabrication facilities shall be in accordance with Sections 16.3.3.1 through 16.3.3.8.
- 16.3.3.1 Fabrication areas.** Construction and location of fabrication areas shall comply with the SBC 201.
- 16.3.3.2 Pass-through in exit access corridors.** Pass-through in exit access corridors shall be constructed in accordance with the SBC 201.
- 16.3.3.3 Liquid storage rooms.** Liquid storage rooms shall comply with Chapter 32 and the SBC 201.
- 16.3.3.4 HPM rooms.** HPM rooms shall comply with the SBC 201.
- 16.3.3.5 Gas cabinets.** Gas cabinets shall comply with Section 25.3.8.6.
- 16.3.3.6 Exhausted enclosures.** Exhausted enclosures shall comply with Section 25.3.8.5.
- 16.3.3.7 Gas rooms.** Gas rooms shall comply with Section 25.3.8.4.
- 16.3.3.8 Service corridors.** Service corridors shall comply with Section 16.5.3 and the SBC 201.
- 16.3.4 Emergency plan.** An emergency plan shall be established as set forth in Section 4.8.4.
- 16.3.5 Maintenance of equipment, machinery and processes.** Maintenance of equipment, machinery and processes shall comply with Section 25.3.2.6.
- 16.3.6 Security of areas.** Areas shall be secured in accordance with Section 25.3.9.2.
- 16.3.7 Electrical wiring and equipment.** Electrical wiring and equipment in HPM facilities shall comply with Sections 16.3.7.1 through 16.3.7.3.
- 16.3.7.1 Fabrication areas.** Electrical wiring and equipment in fabrication areas shall comply with the SBC 401.
- 16.3.7.2 Workstations.** Electrical equipment and devices within 1.5 m of workstations in which flammable or pyrophoric gases or flammable liquids are used shall comply with the SBC 401 for Class I, Division 2 hazardous locations. Workstations shall not be energized without adequate exhaust ventilation in accordance with Section 16.3.14.
- Exception:** Class I, Division 2 hazardous electrical equipment is not required when the air removal from the workstation or dilution will prevent the accumulation of flammable vapors and fumes on a continuous basis.
- 16.3.7.3 Hazardous production material (HPM) rooms, gas rooms and liquid storage rooms.** Electrical wiring and equipment in HPM rooms, gas rooms and liquid storage rooms shall comply with the SBC 401.

- 16.3.8 Exit access corridors and exit enclosures.** Hazardous materials shall not be used or stored in exit access corridors or exit access enclosures.
- 16.3.9 Service corridors.** Hazardous materials shall not be used in an open-system use condition in service corridors.
- 16.3.10 Automatic sprinkler system.** An approved automatic sprinkler system shall be provided in accordance with Sections 16.3.10.1 through 16.3.10.5 and Chapter 7.
- 16.3.10.1 Workstations and tools.** The design of the sprinkler system in the area shall take into consideration the spray pattern and the effect on the equipment.
- 16.3.10.1.1 Combustible workstations.** A sprinkler head shall be installed within each branch exhaust connection or individual plenums of workstations of combustible construction. The sprinkler head in the exhaust connection or plenum shall be located not more than 600 mm from the point of the duct connection or the connection to the plenum. When necessary to prevent corrosion, the sprinkler head and connecting piping in the duct shall be coated with approved or listed corrosion-resistant materials. The sprinkler head shall be accessible for periodic inspection.
- Exceptions:**
1. Approved alternative automatic fire-extinguishing systems are allowed. Activation of such systems shall deactivate the related processing equipment.
  2. Process equipment which operates at temperatures exceeding 500°C and is provided with automatic shutdown capabilities for hazardous materials.
  3. Exhaust ducts 250 mm or less in diameter from flammable gas storage cabinets that are part of a workstation.
  4. Ducts listed or approved for use without internal automatic sprinkler protection.
- 16.3.10.1.2 Combustible tools.** Where the horizontal surface of a combustible tool is obstructed from ceiling sprinkler discharge, automatic sprinkler protection that covers the horizontal surface of the tool shall be provided.
- Exceptions:**
1. An automatic gaseous fire-extinguishing local surface application system shall be allowed as an alternative to sprinklers. Gaseous-extinguishing systems shall be actuated by infrared (IR) or ultraviolet/infrared (UVIR) optical detectors.
  2. Tools constructed of materials that are listed or approved for use without internal fire extinguishing system protection.
- 16.3.10.2 Gas cabinets and exhausted enclosures.** An approved automatic sprinkler system shall be provided in gas cabinets and exhausted enclosures containing HPM compressed gases.
- Exception:** Gas cabinets located in an HPM room other than those cabinets containing pyrophoric gases.
- 16.3.10.3 Pass-through in existing exit access corridors.** Pass-through in existing exit access corridors shall be protected by an approved automatic sprinkler system.
- 16.3.10.4 Exhaust ducts for HPM.** An approved automatic sprinkler system shall be provided in exhaust ducts conveying vapors, fumes, mists or dusts generated from HPM in accordance with this section and the SBC 501.
- 16.3.10.4.1 Metallic and noncombustible nonmetallic exhaust ducts.** An approved automatic sprinkler system shall be provided in metallic and noncombustible nonmetallic exhaust ducts when all of the following conditions apply:
1. When the largest cross-sectional diameter is equal to or greater than 250 mm.
  2. The ducts are within the building.

3. The ducts are conveying flammable vapors or fumes.
- 16.3.10.4.2 **Combustible nonmetallic exhaust ducts.** An approved automatic sprinkler system shall be provided in combustible nonmetallic exhaust ducts when the largest cross-sectional diameter of the duct is equal to or greater than 254 mm.  
**Exceptions:**
  1. Ducts listed or approved for applications without automatic sprinkler system protection.
  2. Ducts not more than 3.7 m in length installed below ceiling level.
- 16.3.10.4.3 **Exhaust connections and plenums of combustible workstations.** Automatic fire-extinguishing system protection for exhaust connections and plenums of combustible workstations shall comply with Section 16.3.14.1.
- 16.3.10.4.4 **Exhaust duct sprinkler system requirements.** Automatic sprinklers installed in exhaust duct systems shall be hydraulically designed to provide 1.9 L/min over an area derived by multiplying the distance between the sprinklers in a horizontal duct by the width of the duct. Minimum discharge shall be 76 L/min per sprinkler from the five hydraulically most remote sprinklers.
  - 16.3.10.4.4.1 **Sprinkler head locations.** Automatic sprinklers shall be installed at 3.7 m intervals in horizontal ducts and at changes in direction. In vertical runs, automatic sprinklers shall be installed at the top and at alternate floor levels.
  - 16.3.10.4.4.2 **Control valve.** A separate indicating control valve shall be provided for sprinklers installed in exhaust ducts.
  - 16.3.10.4.4.3 **Drainage.** Drainage shall be provided to remove sprinkler water discharged in exhaust ducts.
  - 16.3.10.4.4.4 **Corrosive atmospheres.** Where corrosive atmospheres exist, exhaust duct sprinklers and pipe fittings shall be manufactured of corrosion-resistant materials or coated with approved materials.
  - 16.3.10.4.4.5 **Maintenance and inspection.** Sprinklers in exhaust ducts shall be accessible for periodic inspection and maintenance.
- 16.3.10.5 **Sprinkler alarms and supervision.** Automatic sprinkler systems shall be electrically supervised and provided with alarms in accordance with Chapter 7. Automatic sprinkler system alarm and supervisory signals shall be transmitted to the emergency control station.
- 16.3.11 **Manual fire alarm system.** A manual fire alarm system shall be installed throughout buildings containing Group H-5 occupancy. Activation of the alarm system shall initiate a local alarm and transmit a signal to the emergency control station. Manual fire alarm systems shall be designed and installed in accordance with Section 7.7.
- 16.3.12 **Emergency alarm system.** Emergency alarm systems shall be provided in accordance with this section, Section 25.4.9 and Section 25.5.4.4. The maximum allowable quantity per control area provisions of Section 25.4.1 shall not apply to emergency alarm systems required for HPM.
  - 16.3.12.1 **Where required.** Emergency alarm systems shall be provided in the areas indicated in Sections 16.3.12.1.1 through 16.3.12.1.3.
    - 16.3.12.1.1 **Service corridors.** An approved emergency alarm system shall be provided in service corridors, with at least one alarm device in the service corridor.
    - 16.3.12.1.2 **Exit access corridors and exit enclosures.** Emergency alarms for exit access corridors and exit enclosures shall comply with Section 25.4.4.4.
    - 16.3.12.1.3 **Liquid storage rooms, HPM rooms and gas rooms.** Emergency alarms for liquid storage rooms, HPM rooms and gas rooms shall comply with Section

25.4.9.

- 16.3.12.2 Alarm-initiating devices.** An approved emergency telephone system, local alarm manual pull stations, or other approved alarm-initiating devices are allowed to be used as emergency alarm-initiating devices.
- 16.3.12.3 Alarm signals.** Activation of the emergency alarm system shall sound a local alarm and transmit a signal to the emergency control station.
- 16.3.13 Continuous gas detection systems.** A continuous gas detection system shall be provided for HPM gases when the physiological warning properties of the gas are at a higher level than the accepted permissible exposure limit (PEL) for the gas and for flammable gases in accordance with this section.
- 16.3.13.1 Where required.** A continuous gas detection system shall be provided in the areas identified in Sections 16.3.13.1.1 through 16.3.13.1.4.
- 16.3.13.1.1 Fabrication areas.** A continuous gas detection system shall be provided in fabrication areas when gas is used in the fabrication area.
- 16.3.13.1.2 HPM rooms.** A continuous gas detection system shall be provided in HPM rooms when gas is used in the room.
- 16.3.13.1.3 Gas cabinets, exhausted enclosures and gas rooms.** A continuous gas detection system shall be provided in gas cabinets and exhausted enclosures. A continuous gas detection system shall be provided in gas rooms when gases are not located in gas cabinets or exhausted enclosures.
- 16.3.13.1.4 Exit access corridors.** When gases are transported in piping placed within the space defined by the walls of an exit access corridor and the floor or roof above the exit access corridor, a continuous gas detection system shall be provided where piping is located and in the exit access corridor.  
**Exception:** A continuous gas detection system is not required for occasional transverse crossings of the corridors by supply piping which is enclosed in a ferrous pipe or tube for the width of the corridor.
- 16.3.13.2 Gas detection system operation.** The continuous gas detection system shall be capable of monitoring the room, area or equipment in which the gas is located at or below the permissible exposure limit (PEL) or ceiling limit of the gas for which detection is provided. For flammable gases, the monitoring detection threshold level shall be vapor concentrations in excess of 20 percent of the lower flammable limit (LFL). Monitoring for highly toxic and toxic gases shall also comply with Chapter 35.
- 16.3.13.2.1 Alarms.** The gas detection system shall initiate a local alarm and transmit a signal to the emergency control station when a short-term hazard condition is detected. The alarm shall be both visual and audible and shall provide warning both inside and outside the area where the gas is detected. The audible alarm shall be distinct from all other alarms.
- 16.3.13.2.2 Shutoff of gas supply.** The gas detection system shall automatically close the shutoff valve at the source on gas supply piping and tubing related to the system being monitored for which gas is detected when a short-term hazard condition is detected. Automatic closure of shutoff valves shall comply with the following:
1. Where the gas-detection sampling point initiating the gas detection system alarm is within a gas cabinet or exhausted enclosure, the shutoff valve in the gas cabinet or exhausted enclosure for the specific gas detected shall automatically close.
  2. Where the gas-detection sampling point initiating the gas detection system alarm is within a room and compressed gas containers are not in gas cabinets or exhausted enclosure, the shutoff valves on all gas lines for the specific gas

detected shall automatically close.

3. Where the gas-detection sampling point initiating the gas detection system alarm is within a piping distribution manifold enclosure, the shutoff valve supplying the manifold for the compressed gas container of the specific gas detected shall automatically close.

**Exception:** Where the gas-detection sampling point initiating the gas detection system alarm is at the use location or within a gas valve enclosure of a branch line downstream of a piping distribution manifold, the shutoff valve for the branch line located in the piping distribution manifold enclosure shall automatically close.

**16.3.14 Exhaust ventilation systems for HPM.** Exhaust ventilation systems and materials for exhaust ducts utilized for the exhaust of HPM shall comply with this section, other applicable provisions of these code requirements, the SBC 201 and the SBC 501.

**16.3.14.1 Where required.** Exhaust ventilation systems shall be provided in the following locations in accordance with the requirements of this section and the SBC 201:

1. Fabrication areas: Exhaust ventilation for fabrication areas shall comply with the SBC 201. The Building code official is authorized to require additional manual control switches.
2. Workstations: A ventilation system shall be provided to capture and exhaust fumes and vapors at workstations.
3. Liquid storage rooms: Exhaust ventilation for liquid storage rooms shall comply with Section 25.4.3.1 and the SBC 201.
4. HPM rooms: Exhaust ventilation for HPM rooms shall comply with Section 25.4.3.1 and the SBC 201.
5. Gas cabinets: Exhaust ventilation for gas cabinets shall comply with Section 25.3.8.6.2. The gas cabinet ventilation system is allowed to connect to a workstation ventilation system. Exhaust ventilation for gas cabinets containing highly toxic or toxic gases shall also comply with Chapter 35.
6. Exhausted enclosures: Exhaust ventilation for exhausted enclosures shall comply with Section 25.3.8.5.2. Exhaust ventilation for exhausted enclosures containing highly toxic or toxic gases shall also comply with Chapter 35.
7. Gas rooms: Exhaust ventilation for gas rooms shall comply with Section 25.3.8.4.2. Exhaust ventilation for gas cabinets containing highly toxic or toxic gases shall also comply with Chapter 35.

**16.3.14.2 Penetrations.** Exhaust ducts penetrating fire barrier assemblies shall be contained in a shaft of equivalent fire-resistance-rated construction. Exhaust ducts shall not penetrate fire walls. Fire dampers shall not be installed in exhaust ducts.

**16.3.14.3 Treatment systems.** Treatment systems for highly toxic and toxic gases shall comply with Chapter 35.

**16.3.15 Emergency power system.** An emergency power system shall be provided in Group H-5 occupancies where required by Section 7.8. The emergency power system shall be designed to supply power automatically to required electrical systems when the normal supply system is interrupted.

**16.3.15.1 Required electrical systems.** Emergency power shall be provided for electrically operated equipment and connected control circuits for the following systems:

1. HPM exhaust ventilation systems.
2. HPM gas cabinet ventilation systems.
3. HPM exhausted enclosure ventilation systems.
4. HPM gas room ventilation systems.



5. HPM gas detection systems.
6. Emergency alarm systems.
7. Manual fire alarm systems.
8. Automatic sprinkler system monitoring and alarm systems.
9. Electrically operated systems required elsewhere in these code requirements or in the SBC 201 applicable to the use, storage or handling of HPM.

**16.3.15.2 Exhaust ventilation systems.** Exhaust ventilation systems are allowed to be designed to operate at not less than one-half the normal fan speed on the emergency power system when it is demonstrated that the level of exhaust will maintain a safe atmosphere.

## SECTION 16.4 STORAGE

**16.4.1 General.** Storage of hazardous materials shall comply with Section 16.3 and this section and other applicable provisions of these code requirements.

**16.4.2 Fabrication areas.** Storage of HPM in fabrication areas shall be within approved or listed storage cabinets, gas cabinets or within a workstation. Flammable and combustible liquid storage cabinets shall comply with Chapter 32. Hazardous materials storage cabinets shall comply with Section 25.3.8.7. Gas cabinets shall comply with Section 25.3.8.6. Gas cabinets for highly toxic or toxic gases shall also comply with Chapter 35. Workstations shall comply with Section 16.5.2.2.

**16.4.2.1 Maximum aggregate quantities.** The aggregate quantities of hazardous materials stored and used in a single fabrication area shall not exceed the quantities set forth in Table 16.4.2.1.

**Exception:** Fabrication areas containing quantities of hazardous materials not exceeding the maximum allowable quantities per control area established by Chapters 25 and 32.

**16.4.2.2 Maximum quantities of HPM.** The maximum quantities of HPM stored in a single fabrication area shall not exceed the maximum allowable quantities per control area established by Chapters 25 and 32.

**16.4.3 Storage rooms.** The storage of HPM in quantities greater than those listed in Chapters 25 and 32 shall be in a room complying with the requirements of the SBC 201 and these code requirements for a liquid storage room, HPM room or gas room as appropriate for the materials stored. The storage of other hazardous materials shall comply with Chapter 25 and other applicable provisions of these code requirements.

**16.4.3.1 Separation of incompatible hazardous materials.** Incompatible hazardous materials in storage shall be separated from each other in accordance with Section 25.3.9.8.

## SECTION 16.5 USE AND HANDLING

**16.5.1 General.** The use and handling of hazardous materials shall comply with this section, Section 16.3 and other applicable provisions of these code requirements.

**16.5.2 Fabrication areas.** Hazardous production materials located in fabrication areas shall be within approved or listed storage cabinets, gas cabinets or within a workstation.

**16.5.2.1 Maximum aggregate quantities.** The aggregate quantities of hazardous materials in a single fabrication area shall comply with Sections 16.4.2.1 and 16.4.2.2, and Table 16.4.2.1. The quantity of HPM in use at a workstation shall not exceed the quantities listed in Table 16.5.2.1.

**TABLE 16.4.2.1**  
**QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN**  
**GROUP H-5<sup>a</sup>**

HAZARD CATEGORY	SOLIDS (kgs/square meters)	LIQUIDS (liters/square meters)	GAS (cubic meters @ NTP/square meters)
<b>PHYSICAL-HAZARD MATERIALS</b>			
Combustible dust	Note b	Not Applicable	Not Applicable
Combustible fiber Loose Baled	Note b Note b	Not Applicable	Not Applicable
Combustible liquid Class II Class IIIA Class IIIB Combination Class I, II and IIIA	Not Applicable	0.00025 0.0005 Not Limited 0.001	Not Applicable
Cryogenic gas Flammable Oxidizing	Not Applicable	Not Applicable	Note c 0.381
Explosives	Note b	Note b	Note b
Flammable gas Gaseous Liquefied	Not Applicable	Not Applicable	Note c Note c
Flammable liquid Class IA Class IB Class IC Combination Class IA, IB and IC Combination Class I, II and IIIA	Not Applicable	0.00006 0.00063 0.00063 0.00063 0.001	Not Applicable
Flammable solid	0.0049	Not Applicable	Not Applicable
Organic peroxide Unclassified detonable Class I Class II Class III Class IV Class V	Note b Note b 0.122 0.488 Not Limited Not Limited	Not Applicable	Not Applicable
Oxidizing gas Gaseous Liquefied Combination of Gaseous and Liquefied	Not Applicable	Not Applicable	0.381 0.381 0.381

**TABLE 16.4.2.1—continued**  
**QUANTITY LIMITS FOR HAZARDOUS MATERIALS IN A SINGLE FABRICATION AREA IN**  
**GROUP H-5<sup>a</sup>**

<b>HAZARD CATEGORY</b>	<b>SOLIDS (kgs/square meters)</b>	<b>LIQUIDS (liters/square meters)</b>	<b>GAS (cubic meters @ NTP/square meters)</b>
Oxidizer			
Class 4	Note b	Note b	
Class 3	.0146	0.00075	
Class 2	0.0146	0.00075	Not Applicable
Class 1	0.0146	0.00075	
Combination oxidizer Class 1, 2, 3	0.0146	0.00075	
Pyrophoric	Note b	0.00003	Notes c and d
Unstable reactive			
Class 4	Note b	Note b	Note b
Class 3	0.122	0.00006	Note b
Class 2	0.488	0.00025	Note b
Class 1	Not Limited	Not Limited	Not Limited
Water reactive			
Class 3	Note b	0.00003	
Class 2	1.221	0.00063	Not Applicable
Class 1	Not Limited	Not Limited	
<b>HEALTH-HAZARD MATERIALS</b>			
Corrosives	Not Limited	Not Limited	Not Limited
Highly toxics	Not Limited	Not Limited	Note c
Toxics	Not Limited	Not Limited	Note c

- Hazardous materials within piping shall not be included in the calculated quantities.
- Quantity of hazardous materials in a single fabrication shall not exceed the maximum allowable quantities per control area in Tables 25.3.1.1(1) and 25.3.1.1(2).
- The aggregate quantity of flammable, pyrophoric, toxic and highly toxic gases shall not exceed 255 cubic meters at NTP.
- The aggregate quantity of pyrophoric gases in the building shall not exceed the amounts set forth in Table 25.3.8.2.

**TABLE 16.5.2.1**  
**MAXIMUM QUANTITIES OF HPM AT A WORKSTATION<sup>e</sup>**

HPM CLASSIFICATION	STATE	MAXIMUM QUANTITY
Flammable, highly toxic, pyrophoric and toxic combined	Gas	3 cylinders
Flammable	Liquid	57 liters <sup>a, b, c</sup>
	Solid	2.3 kgs <sup>b, c</sup>
Corrosive	Gas	3 cylinders
	Liquid	Use-Open System: 95 liters <sup>a, c</sup>
	Solid	Use-Closed System: 568 liters <sup>a, c, f</sup> 9.1 kgs <sup>b, c</sup>
Highly toxic	Liquid	57 liters <sup>a, b</sup>
	Solid	2.3 kgs <sup>b</sup>
Oxidizer	Gas	3 cylinders
	Liquid	45 liters <sup>a, b, c</sup>
	Solid	9.1 kgs <sup>b, c</sup>
Pyrophoric	Liquid	2 liter <sup>d</sup>
	Solid	See Table 1804.2.1
Toxic	Liquid	57 liters <sup>a, b, c</sup>
	Solid	2.3 kgs <sup>b, c</sup>
Unstable reactive Class 3	Liquid	2 liter <sup>b, c</sup>
	Solid	2.3 kgs <sup>b, c</sup>
Water-reactive Class 3	Liquid	2 liter <sup>d</sup>
	Solid	See Table 16.4.2.1

- a. MOT shipping containers with capacities of greater than 20 liters shall not be located within a workstation.
- b. Maximum allowable quantities shall be increased 100 percent for closed systems operations. When Note c also applies, the increase for both notes shall be allowed.
- c. Quantities shall be allowed to be increased 100 percent when workstations are internally protected with an approved automatic fire-extinguishing or suppression system complying with Chapter 7. When Note b also applies, the increase for both notes shall be allowed. When Note f also applies, the maximum increase allowed for both Notes c and f shall not exceed 100 percent.
- d. Allowed only in workstations that are internally protected with an approved automatic fire-extinguishing or suppression system complying with Chapter 7.
- e. The quantity limits apply only to materials classified as HPM.
- f. Quantities shall be allowed to be increase 100 percent for nonflammable, noncombustible corrosive liquids when the materials of construction for workstations are listed or approved for use without internal fire extinguishing or suppression system protection. When Note c also applies, the maximum increase allowed for both Notes c and f shall not exceed 100 percent.

**16.5.2.2 Workstations.** Workstations in fabrication areas shall be constructed of materials compatible with the materials used and stored at the workstation. The portion of the workstation that serves as a cabinet for HPM gases and flammable liquids shall be noncombustible and, if of metal, shall be not less than 1.2 mm (18 gage) steel.

**16.5.2.2.1 Protection of vessels.** Vessels containing HPM located in or connected to a workstation shall be protected from physical damage and shall not project from the workstation. Hazardous gases and liquid vessels located within a workstation shall be protected from seismic forces in an approved manner in accordance with the SBC 201. Protection for HPM compressed gases shall also comply with Chapter 28.

**16.5.2.2.2 Drainage and containment for HPM liquids.** Each workstation utilizing HPM liquids shall have all of the following:

1. Drainage piping systems connected to a compatible system for disposition of such liquids.
2. The work surface provided with a slope or other means for directing spilled materials to the containment or drainage system.
3. An approved means of containing or directing spilled or leaked liquids to the drainage system.

**16.5.2.2.3 Clearances.** Workstations where HPM is used shall be provided with horizontal servicing clearances of not less than 900 mm for electrical equipment, gas cylinder connections and similar hazardous conditions. These clearances shall apply only to normal operational procedures and not to repair or maintenance-related work.

**16.5.3 Transportation and handling.** The transportation and handling of hazardous materials shall comply with this section and other applicable provisions of these code requirements.

**16.5.3.1 Exit corridors access and exit enclosures.** Exit access corridors and exit enclosures in new buildings or serving new fabrication areas shall not contain HPM except as permitted for exit access corridors by Section 8.16 of the SBC 201.

**16.5.3.2 Transport in existing exit access corridors.** When existing fabrication areas are altered or modified in existing buildings, HPM is allowed to be transported in existing exit access corridors when such exit access corridors comply with the SBC 201. Transportation in exit access corridors shall comply with Section 25.3.10.

**16.5.3.3 Service corridors.** When a new fabrication area is constructed, a service corridor shall be provided where it is necessary to transport HPM from a liquid storage room, HPM room, gas room or from the outside of a building to the perimeter wall of a fabrication area. Service corridors shall be designed and constructed in accordance with the SBC 201.

**16.5.3.4 Carts and trucks.** Carts and trucks used to transport HPM in exit access corridors and exit enclosures in existing buildings shall comply with Section 25.3.10.3.

**16.5.3.4.1 Identification.** Carts and trucks shall be marked to indicate the contents.

**CHAPTER 17**  
**LUMBER YARDS AND WOODWORKING FACILITIES**

**SECTION 17.1**  
**GENERAL**

- 17.1.1 Scope.** The storage, manufacturing and processing of timber, lumber, plywood, veneers and by-products shall be in accordance with this chapter.
- 17.1.2 Permit.** Permits shall be required as set forth in SBC 100.

**SECTION 17.2**  
**DEFINITIONS**

- 17.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**COLD DECK.** A pile of unfinished cut logs.

**FINES.** Small pieces or splinters of wood byproducts that will pass through a 6.4 mm screen.

**HOGGED MATERIALS.** Wood waste materials produced from the lumber production process.

**PLYWOOD and VENEER MILLS.** Facilities where raw wood products are processed into finished wood products, including waferboard, oriented strandboard, fiberboard, composite wood panels and plywood.

**RAW PRODUCT.** A mixture of natural materials such as tree, brush trimmings, or waste logs and stumps.

**STATIC PILES.** Piles in which processed wood product is mounded and is not being turned or moved.

**TIMBER and LUMBER PRODUCTION FACILITIES.** Facilities where raw wood products are processed into finished wood products.

**SECTION 17.3**  
**GENERAL REQUIREMENTS**

- 17.3.1 Open yards.** Open yards required by these code requirements and the SBC 201 shall be maintained around structures.
- 17.3.2 Dust control.** Equipment or machinery located inside buildings which generates or emits combustible dust shall be provided with an approved dust collection and exhaust system installed in accordance with Chapter 12 and the SBC 501. Equipment or systems that are used to collect, process or convey combustible dusts shall be provided with an approved explosion control system.
- 17.3.2.1 Explosion venting.** Where a dust explosion hazard exists in equipment rooms,

buildings or other enclosures, such areas shall be provided with explosion (deflagration) venting or an approved explosion suppression system complying with Section 7.11.

- 17.3.3 Waste removal.** Sawmills, planing mills and other woodworking plants shall be equipped with a waste removal system that will collect and remove sawdust and shavings. Such systems shall be installed in accordance with Chapter 12 and the SBC 501.  
**Exception:** Manual waste removal when approved.
- 17.3.3.1 Housekeeping.** Provisions shall be made for a systematic and thorough cleaning of the entire plant at sufficient intervals to prevent the accumulations of combustible dust and spilled combustible or flammable liquids.
- 17.3.3.2 Metal scrap.** Provision shall be made for separately collecting and disposing of any metal scrap so that such scrap will not enter the wood handling or processing equipment.
- 17.3.4 Electrical equipment.** Electrical wiring and equipment shall comply with the SBC 401.
- 17.3.5 Control of ignition sources.** Protection from ignition sources shall be provided in accordance with Sections 17.3.5.1 through 17.3.5.3.
- 17.3.5.1 Cutting and welding.** Cutting and welding shall comply with Chapter 24.
- 17.3.5.2 Static electricity.** Static electricity shall be prevented from accumulating on machines and equipment subject to static electricity buildup by permanent grounding and bonding wires or other approved means.
- 17.3.5.3 Smoking.** Where smoking constitutes a fire hazard, the fire code official is authorized to order the owner or occupant to post approved “No Smoking” signs complying with Section 5.10. The fire code official is authorized to designate specific locations where smoking is allowed.
- 17.3.6 Fire apparatus access roads.** Fire apparatus access roads shall be provided for buildings and facilities in accordance with Section 5C.3.
- 17.3.7 Access plan.** Where storage pile configurations could change because of changes in product operations and processing, the access plan shall be submitted for approval when required by the fire code official.

## SECTION 17.4 FIRE PROTECTION

- 17.4.1 Fire alarms.** An approved means for transmitting alarms to the Civil Defence shall be provided in timber and lumber production mills and plywood and veneer mills.
- 17.4.1.1 Manual fire alarms.** A manual fire alarm system complying with Section 7.7.2 shall be installed in areas of timber and lumber production mills and for plywood and veneer mills that contain product dryers.  
**Exception:** Where dryers or other sources of ignition are protected by a supervised automatic sprinkler system complying with Section 7.3.
- 17.4.2 Portable fire extinguishers and hose.** Portable fire extinguishers or standpipes and hose supplied from an approved water system shall be provided within 15.3 m of travel distance to any machine producing shavings or sawdust. Extinguishers

shall be provided in accordance with Section 7.6 for extra-high hazards.

- 17.4.3 Automatic sprinkler systems.** Automatic sprinkler systems shall be installed in accordance with Section 7.3.3.1.1.

## **SECTION 17.5 PLYWOOD, VENEER AND COMPOSITE BOARD MILLS**

- 17.5.1 General.** Plant operations of plywood, veneer and composite board mills shall comply with this section.
- 17.5.2 Dryer protection.** Dryers shall be protected throughout by an approved, automatic deluge water-spray suppression system complying with Chapter 7. Deluge heads shall be inspected quarterly for pitch buildup. Deluge heads shall be flushed during regular maintenance for functional operation. Manual activation valves shall be located within 23 m of the drying equipment.
- 17.5.3 Thermal oil-heating systems.** Facilities that use heat transfer fluids to provide process equipment heat through piped, indirect heating systems shall comply with these code and NFPA 664.

## **SECTION 17.6 LOG STORAGE AREAS**

- 17.6.1 General.** Log storage areas shall comply with this section.
- 17.6.2 Cold decks.** Cold decks shall not exceed 152 m in length, 91.5 m in width and 6.1 m in height. Cold decks shall be separated from adjacent cold decks or other exposures by a minimum of 30.5 m.  
**Exception:** The size of cold decks shall be determined by the fire code official where the decks are protected by special fire protection including, but not limited to, additional fire flow, portable turrets and deluge sets, and hydrant hose houses equipped with approved fire-fighting equipment capable of reaching the entire storage area in accordance with Chapter 7.
- 17.6.3 End stops.** Log and pole piles shall be stabilized by approved means.

## **SECTION 17.7 STORAGE OF WOOD CHIPS AND HOGGED MATERIAL ASSOCIATED WITH TIMBER AND LUMBER PRODUCTION FACILITIES**

- 17.7.1 General.** The storage of wood chips and hogged materials associated with timber and lumber production facilities shall comply with this section.
- 17.7.2 Size of piles.** Piles shall not exceed 18.3 m in height, 91.5 m in width and 152 m in length. Piles shall be separated from adjacent piles or other exposures by approved fire apparatus access roads.  
**Exception:** The fire code official is authorized to allow the pile size to be increased when additional fire protection is provided in accordance with Chapter 7. The increase shall be based on the capabilities of the system installed.
- 17.7.3 Pile fire protection.** Automatic sprinkler protection shall be provided in conveyor



tunnels and combustible enclosures that pass under a pile. Combustible or enclosed conveyor systems shall be equipped with an approved automatic sprinkler system.

- 17.7.4 **Material-handling equipment.** Approved material-handling equipment shall be readily available for moving wood chips and hogged material.
- 17.7.5 **Emergency plan.** The owner or operator shall develop a plan for monitoring, controlling and extinguishing spot fires. The plan shall be submitted to the fire code official for review and approval.

## SECTION 17.8 STORAGE AND PROCESSING OF WOOD CHIPS, HOGGED MATERIAL, FINES, COMPOST AND RAW PRODUCT ASSOCIATED WITH YARD WASTE AND RECYCLING FACILITIES

- 17.8.1 **General.** The storage and processing of wood chips, hogged materials, fines, compost and raw product produced from yard waste, debris and recycling facilities shall comply with this section.
- 17.8.2 **Storage site.** Storage sites shall be level and on solid ground or other all-weather surface. Sites shall be thoroughly cleaned before transferring wood products to the site.
- 17.8.3 **Size of piles.** Piles shall not exceed 7.6 m in height, 45.7 m in width and 76.2 m in length.  
**Exception:** The fire code official is authorized to allow the pile size to be increased when additional fire protection is provided in accordance with Chapter 7. The increase shall be based upon the capabilities of the system installed.
- 17.8.4 **Pile separation.** Piles shall be separated from adjacent piles by approved fire apparatus access roads.
- 17.8.5 **Combustible waste.** The storage, accumulation and handling of combustible materials and control of vegetation shall comply with Chapter 5.
- 17.8.6 **Static pile protection.** Static piles shall be monitored by an approved means to measure temperatures within the static piles. Internal pile temperatures shall be monitored and recorded weekly. Records shall be kept on file at the facility and made available for inspection. An operational plan indicating procedures and schedules for the inspection, monitoring and restricting of excessive internal temperatures in static piles shall be submitted to the fire code official for review and approval.
- 17.8.7 **Pile fire protection.** Automatic sprinkler protection shall be provided in conveyor tunnels and combustible enclosures that pass under a pile. Combustible conveyor systems and enclosed conveyor systems shall be equipped with an approved automatic sprinkler system.
- 17.8.8 **Fire extinguishers.** Portable fire extinguishers complying with Section 7.6 and with a minimum rating of 4-A:60-B:C shall be provided on all vehicles and equipment operating on piles and at all processing equipment.

- 17.8.9 Material-handling equipment.** Approved material-handling equipment shall be available for moving wood chips, hogged material, wood fines and raw product during fire-fighting operations.
- 17.8.10 Emergency plan.** The owner or operator shall develop a plan for monitoring, controlling and extinguishing spot fires and submit the plan to the fire code official for review and approval.

## SECTION 17.9

### EXTERIOR STORAGE OF FINISHED LUMBER PRODUCTS

- 17.9.1 General.** Exterior storage of finished lumber products shall comply with this section.
- 17.9.2 Size of piles.** Exterior lumber storage shall be arranged to form stable piles with a maximum height of 6.1 m. Piles shall not exceed  $4.3 \text{ m}^3$  in volume.
- 17.9.3 Fire apparatus access roads.** Fire apparatus access roads in accordance with Section 5C.3 shall be located so that a maximum grid system unit of 15.3 mm by 45.7 mm is established.
- 17.9.4 Security.** Permanent lumber storage areas shall be surrounded with an approved fence. Fences shall be a minimum of 1.8 m in height.  
**Exception:** Lumber piles inside of buildings and production mills for lumber, plywood and veneer.
- 17.9.5 Fire protection.** An approved hydrant and hose system or portable fire-extinguishing equipment suitable for the fire hazard involved shall be provided for open storage yards. Hydrant and hose systems shall be installed in accordance with NFPA 24. Portable fire extinguishers complying with Section 7.6 shall be located so that the travel distance to the nearest unit does not exceed 23 m.

## CHAPTER 18 MANUFACTURE OF ORGANIC COATINGS

### SECTION 18.1 GENERAL

- 18.1.1 Scope.** Organic coating manufacturing processes shall comply with this chapter except that this chapter shall not apply to processes manufacturing nonflammable or water-thinned coatings or to operations applying coating materials.
- 18.1.2 Permits.** Permits shall be required as set forth in SBC 100.
- 18.1.3 Maintenance.** Structures and their service equipment shall be maintained in accordance with these code requirements and NFPA 35.

### SECTION 18.2 DEFINITIONS

- 18.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.
- ORGANIC COATING.** A liquid mixture of binders such as alkyd, nitrocellulose, acrylic or oil, and flammable and combustible solvents such as hydrocarbon, ester, ketone or alcohol, which, when spread in a thin film, convert to a durable protective and decorative finish.

### SECTION 18.3 GENERAL PRECAUTIONS

- 18.3.1 Building features.** Manufacturing of organic coatings shall be done only in buildings that do not have pits or basements.
- 18.3.2 Location.** Organic coating manufacturing operations and operations incidental to or connected with organic coating manufacturing shall not be located in buildings having other occupancies.
- 18.3.3 Fire-fighting access.** Organic coating manufacturing operations shall be accessible from at least one side for the purpose of fire control. Approved aisles shall be maintained for the unobstructed movement of personnel and fire suppression equipment.
- 18.3.4 Fire protection systems.** Fire protection systems shall be installed, maintained, periodically inspected and tested in accordance with Chapter 7.
- 18.3.5 Portable fire extinguishers.** A minimum of one portable fire extinguisher complying with Section 7.6 for extra hazard shall be provided in organic coating areas.
- 18.3.6 Open flames.** Open flames and direct-fired heating devices shall be prohibited in areas where flammable vapor-air mixtures exist.

- 18.3.7 Smoking.** Smoking shall be prohibited in accordance with Section 5.10.
- 18.3.8 Power equipment.** Power-operated equipment and industrial trucks shall be of a type approved for the location.
- 18.3.9 Tank maintenance.** The cleaning of tanks and vessels that have contained flammable or combustible liquids shall be performed under the supervision of persons knowledgeable of the fire and explosion potential.
- 18.3.9.1 Repairs.** Where necessary to make repairs involving “hot work,” the work shall be authorized by the responsible individual before the work begins.
- 18.3.9.2 Empty containers.** Empty flammable or combustible liquid containers shall be removed to a detached, outside location and, if not cleaned on the premises, the empty containers shall be removed from the plant as soon as practical.
- 18.3.10 Drainage.** Drainage facilities shall be provided to direct flammable and combustible liquid leakage and fire protection water to an approved location away from the building, any other structure, storage area or adjoining premises.
- 18.3.11 Alarm system.** An approved fire alarm system shall be provided in accordance with Section 7.7.

## SECTION 18.4 ELECTRICAL EQUIPMENT AND PROTECTION

- 18.4.1 Wiring and equipment.** Electrical wiring and equipment shall comply with this chapter and shall be installed in accordance with the SBC 401.
- 18.4.2 Hazardous locations.** Where Class I liquids are exposed to the air, the design of equipment and ventilation of structures shall be such as to limit the Class I, Division 1, locations to the following:
1. Piping trenches.
  2. The interior of equipment.
  3. The immediate vicinity of pumps or equipment locations, such as dispensing stations, open centrifuges, plate and frame filters, opened vacuum filters, change cans and the surfaces of open equipment. The immediate vicinity shall include a zone extending from the vapor liberation point 1.5 m horizontally in all directions and vertically from the floor to a level 900 mm above the highest point of vapor liberation.
- 18.4.2.1 Other locations.** Locations within the confines of the manufacturing room where Class I liquids are handled shall be Class I, Division 2 except locations indicated in Section 18.4.2.
- 18.4.2.2 Ordinary equipment.** Ordinary electrical equipment, including switchgear, shall be prohibited except where installed in a room maintained under positive pressure with respect to the hazardous area. The air or other media utilized for pressurization shall be obtained from a source that will not cause any amount or type of flammable vapor to be introduced into the room.
- 18.4.3 Bonding.** Equipment including, but not limited to, tanks, machinery and piping, shall be bonded and connected to a ground where an ignitable mixture is capable of being present.
- 18.4.3.1 Piping.** Electrically isolated sections of metallic piping or equipment shall be

grounded or bonded to the other grounded portions of the system.

**18.4.3.2 Vehicles.** Tank vehicles loaded or unloaded through open connections shall be grounded and bonded to the receiving system.

**18.4.3.3 Containers.** Where a flammable mixture is transferred from one portable container to another, a bond shall be provided between the two containers, and one shall be grounded.

**18.4.4 Ground.** Metal framing of buildings shall be grounded with resistance of not more than 5 ohms.

## SECTION 18.5 PROCESS STRUCTURES

**18.5.1 Design.** Process structures shall be designed and constructed in accordance with the SBC 100.

**18.5.2 Fire apparatus access.** Fire apparatus access complying with Section 5A.3 shall be provided for the purpose of fire control to at least one side of organic coating manufacturing operations.

**18.5.3 Drainage.** Drainage facilities shall be provided in accordance with Section 18.3.10 where topographical conditions are such that flammable and combustible liquids are capable of flowing from the organic coating manufacturing operation so as to constitute a fire hazard to other premises.

**18.5.4 Explosion control.** Explosion control shall be provided in areas subject to potential deflagration hazards as indicated in NFPA 35. Explosion control shall be provided in accordance with Section 7.11.

**18.5.5 Ventilation.** Enclosed structures in which Class I liquids are processed or handled shall be ventilated at a rate of not less than  $0.0051 \text{ m}^3/\text{s} \cdot \text{m}^2$  of solid floor area. Ventilation shall be accomplished by exhaust fans that take suction at floor levels and discharge to a safe location outside the structure. Non-contaminated intake air shall be introduced in such a manner that all portions of solid floor areas are provided with continuous uniformly distributed air movement.

**18.5.6 Heating.** Heating provided in hazardous areas shall be by indirect means. Ignition sources such as open flames or electrical heating elements, except as provided for in Section 18.4, shall not be permitted within the structure.

## SECTION 18.6 PROCESS MILLS AND KETTLES

**18.6.1 Mills.** Mills, operating with close clearances, which process flammable and heat-sensitive materials, such as nitrocellulose, shall be located in a detached building or in a noncombustible structure without other occupancies. The amount of nitrocellulose or other flammable material brought into the area shall not be more than the amount required for a batch.

**18.6.2 Mixers.** Mixers shall be of the enclosed type or, where of the open type, shall be provided with properly fitted covers. Where flow is by gravity, a shutoff valve

shall be installed as close as practical to the mixer, and a control valve shall be provided near the end of the fill pipe.

- 18.6.3 Open kettles.** Open kettles shall be located in an outside area provided with a protective roof; in a separate structure of noncombustible construction; or separated from other areas by a noncombustible wall having a fire-resistance rating of at least 2 hours.
- 18.6.4 Closed kettles.** Contact-heated kettles containing solvents shall be equipped with safety devices that, in case of a fire, will turn off the process heat, turn on the cooling medium and inject inert gas into the kettle.
- 18.6.4.1 Vaporizer location.** The vaporizer section of heat-transfer systems that heat closed kettles containing solvents shall be remotely located.
- 18.6.5 Kettle controls.** The kettle and thin-down tank shall be instrumented, controlled and interlocked so that any failure of the controls will result in a safe condition. The kettle shall be provided with a pressure-rupture disc in addition to the primary vent. The vent piping from the rupture disc shall be of minimum length and shall discharge to an approved location. The thin-down tank shall be adequately vented. Thinning operations shall be provided with an adequate vapor removal system.

## SECTION 18.7 PROCESS PIPING

- 18.7.1 Design.** All piping, valves and fittings shall be designed for the working pressures and structural stresses to which the piping, valves and fittings will be subjected, and shall be of steel or other material approved for the service intended.
- 18.7.2 Valves.** Valves shall be of an indicating type. Terminal valves on remote pumping systems shall be of the dead-man type, shutting off both the pump and the flow of solvent.
- 18.7.3 Support.** Piping systems shall be supported adequately and protected against physical damage. Piping shall be pitched to avoid unintentional trapping of liquids, or approved drains shall be provided.
- 18.7.4 Connectors.** Approved flexible connectors shall be installed where vibration exists or frequent movement is necessary. Hose at dispensing stations shall be of an approved type.
- 18.7.5 Tests.** Before being placed in service, all piping shall be free of leaks when tested for a minimum of 30 minutes at not less than 1.5 times the working pressure or a minimum of 35 kPa at the highest point in the system.

## SECTION 18.8 RAW MATERIALS IN PROCESS AREAS

- 18.8.1 Nitrocellulose quantity.** The amount of nitrocellulose brought into the operating area shall not exceed the amount required for a work shift. Nitrocellulose spillage shall be promptly swept up and disposed of properly.

- 18.8.2 Organic peroxides quantity.** Organic peroxides brought into the operating area shall be in the original shipping container. When in the operating area, the organic peroxide shall not be placed in locations exposed to ignition sources, heat or mechanical shocks.

## SECTION 18.9

### RAW MATERIALS AND FINISHED PRODUCTS

- 18.9.1 General.** The storage, handling and use of flammable and combustible liquids in process areas shall be in accordance with Chapter 32.
- 18.9.2 Tank storage.** Tank storage for flammable and combustible liquids located inside of structures shall be limited to storage areas at or above grade which are separated from the processing area in accordance with the SBC requirements. Processing equipment containing flammable and combustible liquids and storage in quantities essential to the continuity of the operations shall not be prohibited in the processing area.
- 18.9.3 Tank vehicle.** Tank car and tank vehicle loading and unloading stations for Class I liquids shall be separated from the processing area, other plant structures, nearest lot line of property that can be built upon or public thoroughfare by a minimum clear distance of 7.6 m.
- 18.9.3.1 Loading.** Loading and unloading structures and platforms for flammable and combustible liquids shall be designed and installed in accordance with Chapter 32.
- 18.9.3.2 Safety.** Tank cars for flammable liquids shall be unloaded such that the safety to persons and property is ensured. Tank vehicles for flammable and combustible liquids shall be loaded and unloaded in accordance with Chapter 32.
- 18.9.4 Nitrocellulose storage.** Nitrocellulose storage shall be located on a detached pad or in a separate structure or a room enclosed in accordance with the SBC 100. The nitrocellulose storage area shall not be utilized for any other purpose. Electrical wiring and equipment installed in storage areas adjacent to process areas shall comply with Section 18.4.2.
- 18.9.4.1 Containers.** Nitrocellulose shall be stored in closed containers. Barrels shall be stored on end and not more than two tiers high. Barrels or other containers of nitrocellulose shall not be opened in the main storage structure but at the point of use or other location intended for that purpose.
- 18.9.4.2 Spills.** Spilled nitrocellulose shall be promptly wetted with water and disposed of by use or burning in the open at an approved detached location.
- 18.9.5 Organic peroxide storage.** The storage of organic peroxides shall be in accordance with Chapter 37.
- 18.9.5.1 Size.** The size of the package containing organic peroxide shall be selected so that, as nearly as practical, full packages are utilized at one time. Spilled peroxide shall be promptly cleaned up and disposed of as specified by the supplier.
- 18.9.6 Finished products.** Finished products that are flammable or combustible liquids shall be stored outside of structures, in a separate structure, or in a room separated from the processing area in accordance with the SBC 201. The storage of finished products shall be in tanks or closed containers in accordance with Chapter 32.

## CHAPTER 19 INDUSTRIAL OVENS

### SECTION 19.1 GENERAL

- 19.1.1 Scope.** This chapter shall apply to the installation and operation of industrial ovens and furnaces. Industrial ovens and furnaces shall comply with the applicable provisions of NFPA 86, the, SBC 501 and this chapter. The terms “ovens” and “furnaces” are used interchangeably in this chapter.
- 19.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 19.2 DEFINITIONS

- 19.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**FURNACE CLASS A.** An oven or furnace that has heat utilization equipment operating at approximately atmospheric pressure wherein there is a potential explosion or fire hazard that could be occasioned by the presence of flammable volatiles or combustible materials processed or heated in the furnace.

**Note:** Such flammable volatiles or combustible materials can, for instance, originate from the following:

1. Paints, powders, inks, and adhesives from finishing processes, such as dipped, coated, sprayed and impregnated materials.
2. The substrate material.
3. Wood, paper and plastic pallets, spacers or packaging materials.
4. Polymerization or other molecular rearrangements. Potentially flammable materials, such as quench oil, water-borne finishes, cooling oil or cooking oils that present a hazard are ventilated according to Class A standards.

**FURNACE CLASS B.** An oven or furnace that has heat utilization equipment operating at approximately atmospheric pressure wherein there are no flammable volatiles or combustible materials being heated.

**FURNACE CLASS C.** An oven or furnace that has a potential hazard due to a flammable or other special atmosphere being used for treatment of material in process. This type of furnace can use any type of heating system and includes a special atmosphere supply system. Also included in the Class C classification are integral quench furnaces and molten salt bath furnaces.

**FURNACE CLASS D.** An oven or furnace that operates at temperatures from above ambient to over 2,760°C and at pressures normally below atmospheric using any type of heating system. These furnaces can include the use of special processing atmospheres.



### SECTION 19.3 LOCATION

- 19.3.1 Ventilation.** Enclosed rooms or basements containing industrial ovens or furnaces shall be provided with combustion air in accordance with the SBC 501, and with ventilation air in accordance with the SBC 501.
- 19.3.2 Exposure.** When locating ovens, oven heaters and related equipment, the possibility of fire resulting from overheating or from the escape of fuel gas or fuel oil and the possibility of damage to the building and injury to persons resulting from explosion shall be considered.
- 19.3.3 Ignition source.** Industrial ovens and furnaces shall be located so as not to pose an ignition hazard to flammable vapors or mists or combustible dusts.
- 19.3.4 Temperatures.** Roofs and floors of ovens shall be insulated and ventilated to prevent temperatures at combustible ceilings and floors from exceeding 71°C.

### SECTION 19.4 FUEL PIPING

- 19.4.1 Fuel-gas piping.** Fuel-gas piping serving industrial ovens shall be designed and installed with approved methods. Piping for other fuel sources shall comply with this section.
- 19.4.2 Shutoff valves.** Each industrial oven or furnace shall be provided with an approved manual fuel shutoff valve in accordance with the SBC 501.
- 19.4.2.1 Fuel supply lines.** Valves for fuel supply lines shall be located within 1.8 m of the appliance served.  
**Exception:** When approved and the valve is located in the same general area as the appliance served.
- 19.4.3 Valve position.** The design of manual fuel shutoff valves shall incorporate a permanent feature which visually indicates the open or closed position of the valve. Manual fuel shutoff valves shall not be equipped with removable handles or wrenches unless the handle or wrench can only be installed parallel with the fuel line when the valve is in the open position.

### SECTION 19.5 INTERLOCKS

- 19.5.1 Shutdown.** Interlocks shall be provided for Class A ovens so that conveyors or sources of flammable or combustible materials shall shutdown if either the exhaust or recirculation air supply fails.

### SECTION 19.6 FIRE PROTECTION

- 19.6.1 Required protection.** Class A and B ovens which contain, or are utilized for the processing of, combustible materials shall be protected by an approved automatic fire-extinguishing system complying with Chapter 7.

- 19.6.2 Fixed fire-extinguishing systems.** Fixed fire-extinguishing systems shall be provided for Class C or D ovens to protect against such hazards as overheating, spillage of molten salts or metals, quench tanks, ignition of hydraulic oil and escape of fuel. It shall be the user's responsibility to consult with the Building code official concerning the necessary requirements for such protection.
- 19.6.3 Fire extinguishers.** Portable fire extinguishers complying with Section 7.6 shall be provided not closer than 4.6 m or a maximum of 15.2 m or in accordance with NFPA 10. This shall apply to the oven and related equipment.

## **SECTION 19.7 OPERATION AND MAINTENANCE**

- 19.7.1 Furnace system information.** An approved, clearly worded, and prominently displayed safety design data form or manufacturer's nameplate shall be provided stating the safe operating condition for which the furnace system was designed, built, altered or extended.
- 19.7.2 Oven nameplate.** Safety data for Class A solvent atmosphere ovens shall be furnished on the manufacturer's nameplate. The nameplate shall provide the following design data:
- 1.** The solvent used.
  - 2.** The number of liters used per batch or per hour of solvent entering the oven.
  - 3.** The required purge time.
  - 4.** The oven operating temperature.
  - 5.** The exhaust blower rating for the number of liters of solvent per hour or batch at the maximum operating temperature.
- Exception:** For low-oxygen ovens, the maximum allowable oxygen concentration shall be included in place of the exhaust blower ratings.
- 19.7.3 Training.** Operating, maintenance and supervisory personnel shall be thoroughly instructed and trained in the operation of ovens or furnaces.
- 19.7.4 Equipment maintenance.** Equipment shall be maintained in accordance with the manufacturer's instructions.

## CHAPTER 20

### MOTOR FUEL-DISPENSING FACILITIES AND REPAIR GARAGES

#### SECTION 20.1

##### GENERAL

- 20.1.1 Scope.** Automotive motor fuel-dispensing facilities, marine motor fuel-dispensing facilities, fleet vehicle motor fuel-dispensing facilities and repair garages shall be in accordance with this chapter and the SBC 100, and the SBC 501. Such operations shall include both operations that are accessible to the public and private operations.
- 20.1.2 Permits.** Permits shall be required as set forth in SBC 100.
- 20.1.3 Construction documents.** Construction documents shall be submitted for review and approval prior to the installation or construction of automotive, marine or fleet vehicle motor fuel-dispensing facilities and repair garages in accordance with SBC 100.
- 20.1.4 Indoor motor fuel-dispensing facilities.** Motor fuel-dispensing facilities located inside buildings shall comply with the SBC 201 and NFPA 30A.
- 20.1.4.1 Protection of floor openings in indoor motor fuel-dispensing facilities.** Where motor fuel-dispensing facilities are located inside buildings and the dispensers are located above spaces within the building, openings beneath dispensers shall be sealed to prevent the flow of leaked fuel to lower building spaces.
- 20.1.5 Electrical.** Electrical wiring and equipment shall be suitable for the locations in which they are installed and shall comply with Section 6.5, NFPA 30A and the SBC 401.
- 20.1.6 Heat-producing appliances.** Heat-producing appliances shall be suitable for the locations in which they are installed and shall comply with NFPA 30A, and/or the SBC 501.

#### SECTION 20.2

##### DEFINITIONS

- 20.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**AUTOMOTIVE MOTOR FUEL-DISPENSING FACILITY.** That portion of property where flammable or combustible liquids or gases used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles.

**DISPENSING DEVICE, OVERHEAD TYPE.** A dispensing device that consists of one or more individual units intended for installation in conjunction with each other, mounted above a dispensing area typically within the motor fuel-dispensing facility canopy structure, and characterized by the use of an overhead hose reel.

**FLEET VEHICLE MOTOR FUEL-DISPENSING FACILITY.** That portion of a commercial, industrial, governmental or manufacturing property where liquids used as fuels are stored and dispensed into the fuel tanks of motor vehicles that are used in connection with such businesses, by persons within the employ of such businesses.

**LIQUEFIED NATURAL GAS (LNG).** A fluid in the liquid state composed predominantly of methane and which may contain minor quantities of ethane, propane, nitrogen or other components normally found in natural gas.

**MARINE MOTOR FUEL-DISPENSING FACILITY.** That portion of property where flammable or combustible liquids or gases used as fuel for watercraft are stored and dispensed from fixed equipment on shore, piers, wharves, floats or barges into the fuel tanks of watercraft and shall include all other facilities used in connection therewith.

**REPAIR GARAGE.** A building, structure or portion thereof used for servicing or repairing motor vehicles.

**SELF-SERVICE MOTOR FUEL-DISPENSING FACILITY.** That portion of motor fuel-dispensing facility where liquid motor fuels are dispensed from fixed approved dispensing equipment into the fuel tanks of motor vehicles by persons other than a motor fuel-dispensing facility attendant.

### **SECTION 20.3 LOCATION OF DISPENSING DEVICES**

**20.3.1 Location of dispensing devices.** Dispensing devices shall be located as follows:

- 1.** 3 m or more from lot lines.
- 2.** 3 m or more from buildings having combustible exterior wall surfaces or buildings having noncombustible exterior wall surfaces that are not part of a one hour fire-resistance-rated assembly or buildings having combustible overhangs.  
**Exception:** Canopies constructed in accordance with the SBC 201 providing weather protection for the fuel islands.
- 3.** Such that all portions of the vehicle being fueled will be on the premises of the motor fuel-dispensing facility.
- 4.** Such that the nozzle, when the hose is fully extended, will not reach within 1.5 m of building openings.
- 5.** 6.1 m or more from fixed sources of ignition.

**20.3.2 Emergency disconnect switches.** An approved, clearly identified and readily accessible emergency disconnect switch shall be provided at an approved location, to stop the transfer of fuel to the fuel dispensers in the event of a fuel spill or other emergency. An emergency disconnect switch for exterior fuel dispensers shall be located within 30.5 m of, but not less than 6.1 m from, the fuel dispensers. For interior fuel-dispensing operations, the emergency disconnect switch shall be installed at an approved location. Such devices shall be distinctly labeled as: EMERGENCY FUEL SHUTOFF. Signs shall be provided in approved locations.

## SECTION 20.4

### DISPENSING OPERATIONS

- 20.4.1 Supervision of dispensing.** The dispensing of fuel at motor fuel-dispensing facilities shall be conducted by a qualified attendant or shall be under the supervision of a qualified attendant at all times or shall be in accordance with Section 20.4.3.
- 20.4.2 Attended self-service motor fuel-dispensing facilities.** Attended self-service motor fuel-dispensing facilities shall comply with Sections 20.4.2.1 through 20.4.2.5. Attended self-service motor fuel-dispensing facilities shall have at least one qualified attendant on duty while the facility is open for business. The attendant's primary function shall be to supervise, observe and control the dispensing of fuel. The attendant shall prevent the dispensing of fuel into containers that do not comply with Section 20.4.4.1, control sources of ignition, give immediate attention to accidental spills or releases, and be prepared to use fire extinguishers.
- 20.4.2.1 Special-type dispensers.** Approved special-dispensing devices and systems such as, but not limited to, card or coin-operated and remote-preset types, are allowed at motor fuel-dispensing facilities provided there is at least one qualified attendant on duty while the facility is open to the public. Remote preset-type devices shall be set in the "off" position while not in use so that the dispenser cannot be activated without the knowledge of the attendant.
- 20.4.2.2 Emergency controls.** Approved emergency controls shall be provided in accordance with Section 20.3.2.
- 20.4.2.3 Operating instructions.** Dispenser operating instructions shall be conspicuously posted in approved locations on every dispenser.
- 20.4.2.4 Obstructions to view.** Dispensing devices shall be in clear view of the attendant at all times. Obstructions shall not be placed between the dispensing area and the attendant.
- 20.4.2.5 Communications.** The attendant shall be able to communicate with persons in the dispensing area at all times. An approved method of communicating with the Civil Defence shall be provided for the attendant.
- 20.4.3 Unattended self-service motor fuel-dispensing facilities.** Unattended self-service motor fuel-dispensing facilities shall comply with Sections 20.4.3.1 through 20.4.3.7.
- 20.4.3.1 General.** Where approved, unattended self-service motor fuel-dispensing facilities are allowed. As a condition of approval, the owner or operator shall provide, and be accountable for, daily site visits, regular equipment inspection and maintenance.
- 20.4.3.2 Dispensers.** Dispensing devices shall comply with Section 20.6.7. Dispensing devices operated by the insertion of coins or currency shall not be used unless approved.
- 20.4.3.3 Emergency controls.** Approved emergency controls shall be provided in accordance with Section 20.3.2. Emergency controls shall be of a type which is only manually resettable.
- 20.4.3.4 Operating instructions.** Dispenser operating instructions shall be conspicuously posted in approved locations on every dispenser and shall indicate the location of the emergency controls required by Section 20.4.3.3.

- 20.4.3.5 Emergency procedures.** An approved emergency procedures sign, in addition to the signs required by Section 20.5.6, shall be posted in a conspicuous location and shall read:

IN CASE OF FIRE, SPILL OR RELEASE  
1. USE EMERGENCY PUMP SHUTOFF  
2. REPORT THE ACCIDENT!  
CIVIL DEFENCE TELEPHONE NO. \_\_\_\_\_  
FACILITY ADDRESS. \_\_\_\_\_

- 20.4.3.6 Communications.** A telephone not requiring a coin to operate or other approved, clearly identified means to notify the Civil Defence shall be provided on the site in a location approved by the Building code official.

- 20.4.3.7 Quantity limits.** Dispensing equipment used at unsupervised locations shall comply with one of the following:

1. Dispensing devices shall be programmed or set to limit uninterrupted fuel delivery to 95 L and require a manual action to resume delivery.
2. The amount of fuel being dispensed shall be limited in quantity by a preprogrammed card as approved.

- 20.4.4 Dispensing into portable containers.** The dispensing of flammable or combustible liquids into portable approved containers shall comply with Sections 20.4.4.1 through 20.4.4.3.

- 20.4.4.1 Approved containers required.** Class I, II and IIIA liquids shall not be dispensed into a portable container unless such container is of approved material and construction, and has a tight closure with screwed or spring-loaded cover so designed that the contents can be dispensed without spilling. Liquids shall not be dispensed into portable tanks or cargo tanks.

- 20.4.4.2 Nozzle operation.** A hose nozzle valve used for dispensing Class I liquids into a portable container shall be in compliance with Section 20.6.7.6 and be manually held open during the dispensing operation.

- 20.4.4.3 Location of containers being filled.** Portable containers shall not be filled while located inside the trunk, passenger compartment or truck bed of a vehicle.

## SECTION 20.5 OPERATIONAL REQUIREMENTS

- 20.5.1 Tank filling operations for Class I, II or IIIA liquids.** Delivery operations to tanks for Class I, II or IIIA liquids shall comply with Sections 20.5.1.1 through 20.5.1.3 and the applicable requirements of Chapter 32.

- 20.5.1.1 Delivery vehicle location.** Where liquid delivery to above-ground storage tanks is accomplished by positive-pressure operation, tank vehicles shall be positioned a minimum of 7.6 m from tanks receiving Class I liquids and 4.6 m from tanks receiving Class II and IIIA liquids.

- 20.5.1.2 Tank capacity calculation.** The driver, operator or attendant of a tank vehicle shall, before making delivery to a tank, determine the unfilled, available capacity of such tank by an approved gauging device.

- 20.5.1.3 Tank fill connections.** Delivery of flammable liquids to tanks more than 3,785 L in capacity shall be made by means of approved liquid and vapor-tight connections between the delivery hose and tank fill pipe. Where tanks are equipped with any type of vapor recovery system, all connections required to be made for the safe and proper functioning of the particular vapor recovery process shall be made. Such connections shall be made liquid and vapor tight and remain connected

throughout the unloading process. Vapors shall not be discharged at grade level during delivery.

- 20.5.2 Equipment maintenance and inspection.** Motor fuel-dispensing facility equipment shall be maintained in proper working order at all times in accordance with Sections 20.5.2.1 through 20.5.2.3.
- 20.5.2.1 Dispensing devices.** Where maintenance to Class I liquid dispensing devices becomes necessary and such maintenance could allow the accidental release or ignition of liquid, the following precautions shall be taken before such maintenance is begun:
1. Only persons knowledgeable in performing the required maintenance shall perform the work.
  2. Electrical power to the dispensing device and pump serving the dispenser shall be shutoff at the main electrical disconnect panel.
  3. The emergency shutoff valve at the dispenser, where installed, shall be closed.
  4. Vehicle traffic and unauthorized persons shall be prevented from coming within 3.7 m of the dispensing device.
- 20.5.2.2 Emergency shutoff valves.** Automatic-closing emergency shutoff valves required by Section 20.6.7.4 shall be checked not less than once per year by manually tripping the hold-open linkage.
- 20.5.2.3 Leak detectors.** Leak detection devices required by Section 20.6.7.7.1 shall be checked and tested at least annually in accordance with the manufacturer's specifications to ensure proper installation and operation.
- 20.5.3 Spill control.** Provisions shall be made to prevent liquids spilled during dispensing operations from flowing into buildings. Acceptable methods include, but shall not be limited to, grading driveways, raising doorsills, or other approved means.
- 20.5.4 Sources of ignition.** Smoking and open flames shall be prohibited in areas where fuel is dispensed. The engines of vehicles being fueled shall be shutoff during fueling. Electrical equipment shall be in accordance with the SBC 401.
- 20.5.5 Fire extinguishers.** Approved portable fire extinguishers complying with Section 7.6 with a minimum rating of 2-A:20-B:C shall be provided and located such that an extinguisher is not more than 22.9 m from pumps, dispensers or storage tank fill-pipe openings.
- 20.5.6 Warning signs.** Warning signs shall be conspicuously posted within sight of each dispenser in the fuel-dispensing area and shall state the following:
1. It is illegal and dangerous to fill unapproved containers with fuel.
  2. Smoking is prohibited.
  3. The engine shall be shutoff during the refueling process.
  4. Portable containers shall not be filled while located inside the trunk, passenger compartment, or truck bed of a vehicle.
- 20.5.7 Control of brush and debris.** Fenced and diked areas surrounding above-ground tanks shall be kept free from vegetation, debris and other material that is not necessary to the proper operation of the tank and piping system. Weeds, grass, brush, trash and other combustible materials shall be kept not less than 3 m from fuel-handling equipment.

**SECTION 20.6**  
**FLAMMABLE AND COMBUSTIBLE LIQUID MOTOR**  
**FUEL-DISPENSING FACILITIES**

- 20.6.1 General.** Storage of flammable and combustible liquids shall be in accordance with Chapter 32 and this section.
- 20.6.2 Method of storage.** Approved methods of storage for Class I, II and IIIA liquid fuels at motor fuel-dispensing facilities shall be in accordance with Sections 20.6.2.1 through 20.6.2.5.
- 20.6.2.1 Underground tanks.** Underground tanks for the storage of Class I, II and IIIA liquid fuels shall comply with Chapter 32.
- 20.6.2.1.1 Inventory control for underground tanks.** Accurate daily inventory records shall be maintained and reconciled on underground fuel storage tanks for indication of possible leakage from tanks and piping. The records shall be kept at the premises or made available for inspection by the Building code official within 24 hours of a written or verbal request and shall include records for each product showing daily reconciliation between sales, use, receipts and inventory on hand. Where there is more than one system consisting of tanks serving separate pumps or dispensers for a product, the reconciliation shall be ascertained separately for each tank system. A consistent or accidental loss of product shall be immediately reported to the Building code official.
- 20.6.2.2 Above-ground tanks located inside buildings.** Above-ground tanks for the storage of Class I, II and IIIA liquid fuels are allowed to be located in buildings. Such tanks shall be located in special enclosures complying with Section 20.6.2.6, in a liquid storage room or a liquid storage warehouse complying with Chapter 32, or shall be listed and labeled as protected above-ground tanks.
- 20.6.2.3 Above-ground tanks located outside, above grade.** Above-ground tanks shall not be used for the storage of Class I, II or IIIA liquid fuels except as provided by this section.
- 1.** Above-ground tanks used for outside, above-grade storage of Class I liquids shall be listed and labeled as protected above-ground tanks and be in accordance with Chapter 32. Such tanks shall be located in accordance with Table 20.6.2.3.
  - 2.** Above-ground tanks used for above-grade storage of Class II or IIIA liquids are allowed to be protected above-ground tanks or, when approved by the Building code official, other above-ground tanks that comply with Chapter 32. Tank locations shall be in accordance with Table 20.6.2.3.
  - 3.** Tanks containing fuels shall not exceed 45,420 L in individual capacity or 181,680 L in aggregate capacity. Installations with the maximum allowable aggregate capacity shall be separated from other such installations by not less than 30.5 m.
  - 4.** Tanks located at farms, construction projects, or rural areas shall comply with Section 32.6.2.



**TABLE 20.6.2.3**  
**MINIMUM SEPARATION REQUIREMENTS FOR ABOVE-GROUND TANKS**

CLASS OF LIQUID AND TANK TYPE	INDIVIDUAL TANK CAPACITY (liters)	MINIMUM DISTANCE FROM NEAREST IMPORTANT BUILDING ON SAME PROPERTY (meters)	MINIMUM DISTANCE FROM NEAREST FUEL DISPENSER (meters)	MINIMUM DISTANCE FROM LOT LINE WHICH IS OR CAN BE BUILT UPON, INCLUDING THE OPPOSITE SIDE OF A PUBLIC WAY (meters)	MINIMUM DISTANCE FROM NEAREST SIDE OF ANY PUBLIC WAY (meters)	MINIMUM DISTANCE BETWEEN TANKS (meters)
Class I protected above-ground tanks or tanks in vaults	Less than or equal to 22,710	1.5	7.6 <sup>a</sup>	4.6	1.5	0.9
	Greater than 22,710	4.6	7.6 <sup>a</sup>	7.6	4.6	0.9
Class II and III protected above-ground tanks or tanks in vaults	Same as Class I	Same as Class I	Same as Class I	Same as Class I	Same as Class I	Same as Class I
Other tanks	All	15.2	15.2	30.5	15.2	0.9

a. At fleet vehicle motor fuel-dispensing facilities, no minimum separation distance is required.

**20.6.2.4 Above-ground tanks located in above-grade vaults or below-grade vaults.**

Above-ground tanks used for storage of Class I, II or IIIA liquid fuels are allowed to be installed in vaults located above grade or below grade in accordance with Section 32.4.3.2 and shall comply with Sections 20.6.2.4.1 and 20.6.2.4.2. Tanks in above-grade vaults shall also comply with Table 20.6.2.3.

**20.6.2.4.1 Tank capacity limits.** Tanks storing Class I and Class II liquids at an individual site shall be limited to a maximum individual capacity of 56,775 L and an aggregate capacity of 181,680 L.

**20.6.2.4.2 Fleet vehicle motor fuel-dispensing facilities.** Tanks storing Class II and Class IIIA liquids at a fleet vehicle motor fuel-dispensing facility shall be limited to a maximum individual capacity of 75,700 L and an aggregate capacity of 302,800 L.

**20.6.2.5 Portable tanks.** Where approved by the Building code official, portable tanks are allowed to be temporarily used in conjunction with the dispensing of Class I, II or IIIA liquids into the fuel tanks of motor vehicles or motorized equipment on premises not normally accessible to the public. The approval shall include a definite time limit.

**20.6.2.6 Special enclosures.** Where installation of tanks in accordance with Section 32.4.2.11 is impractical, or because of property or building limitations, tanks for liquid fuels are allowed to be installed in buildings in special enclosures in accordance with all of the following:

1. The special enclosure shall be liquid tight and vapor tight.
2. The special enclosure shall not contain backfill.
3. Sides, top and bottom of the special enclosure shall be of reinforced concrete at least 152 mm thick, with openings for inspection through the top only.
4. Tank connections shall be piped or closed such that neither vapors nor liquid can escape into the enclosed space between the special enclosure and any tanks inside the special enclosure.
5. Means shall be provided whereby portable equipment can be employed to

discharge to the outside any vapors which might accumulate inside the special enclosure should leakage occur.

6. Tanks containing Class I, II or IIIA liquids inside a special enclosure shall not exceed 22,710 L in individual capacity or 68,130 L in aggregate capacity.
7. Each tank within special enclosures shall be surrounded by a clear space of not less than 900 mm to allow for maintenance and inspection.

**20.6.3 Security.** Above-ground tanks for the storage of liquid fuels shall be safeguarded from public access or unauthorized entry in an approved manner.

**20.6.4 Physical protection.** Guard posts complying with Chapter 5 or other approved means shall be provided to protect above-ground tanks against impact by a motor vehicle unless the tank is listed as a protected above-ground tank with vehicle impact protection.

**20.6.5 Secondary containment.** Above-ground tanks shall be provided with drainage control or diking in accordance with Chapter 32. Drainage control and diking is not required for listed secondary containment tanks. Secondary containment systems shall be monitored either visually or automatically. Enclosed secondary containment systems shall be provided with emergency venting in accordance with Section 20.6.6.2.5.

**20.6.6 Piping, valves, fittings and ancillary equipment for use with flammable or combustible liquids.** The design, fabrication, assembly, testing and inspection of piping, valves, fittings and ancillary equipment for use with flammable or combustible liquids shall be in accordance with Chapter 32 and Sections 20.6.6.1 through 20.6.6.3.

**20.6.6.1 Protection from damage.** Piping shall be located such that it is protected from physical damage.

**20.6.6.2 Piping, valves, fittings and ancillary equipment for above-ground tanks for Class I, II and IIIA liquids.** Piping, valves, fittings and ancillary equipment for above-ground tanks shall comply with Sections 20.6.6.2.1 through 20.6.6.2.6.

**20.6.6.2.1 Tank openings.** Tank openings for above-ground tanks shall be through the top only.

**20.6.6.2.2 Fill-pipe connections.** The fill pipe for above-ground tanks shall be provided with a means for making a direct connection to the tank vehicle's fuel-delivery hose so that the delivery of fuel is not exposed to the open air during the filling operation. Where any portion of the fill pipe exterior to the tank extends below the level of the top of the tank, a check valve shall be installed in the fill pipe not more than 305 mm from the fill-hose connection.

**20.6.6.2.3 Overfill protection.** Overfill protection shall be provided for above-ground flammable and combustible liquid storage tanks in accordance with Sections 32.4.2.7.5.8 and 32.4.2.9.6.6.

**20.6.6.2.4 Siphon prevention.** An approved antisiphon method shall be provided in the piping system to prevent flow of liquid by siphon action.

**20.6.6.2.5 Emergency relief venting.** Above-ground storage tanks, tank compartments and enclosed secondary containment spaces shall be provided with emergency relief venting in accordance with Chapter 32.

**20.6.6.2.6 Spill containers.** A spill container having a capacity of not less than 19 L shall be provided for each fill connection. For tanks with a top fill connection, spill containers shall be noncombustible and shall be fixed to the tank and equipped

with a manual drain valve that drains into the primary tank. For tanks with a remote fill connection, a portable spill container is allowed.

- 20.6.6.3 Piping, valves, fittings and ancillary equipment for underground tanks.** Piping, valves, fittings and ancillary equipment for underground tanks shall comply with Chapter 32 and NFPA 30A.
- 20.6.7 Fuel-dispensing systems for flammable or combustible liquids.** The design, fabrication and installation of fuel-dispensing systems for flammable or combustible liquid fuels shall be in accordance with this section.
- 20.6.7.1 Listed equipment.** Electrical equipment, dispensers, hose, nozzles and submersible or subsurface pumps used in fuel-dispensing systems shall be listed.
- 20.6.7.2 Fixed pumps required.** Class I and Class II liquids shall be transferred from tanks by means of fixed pumps designed and equipped to allow control of the flow and prevent leakage or accidental discharge.
- 20.6.7.3 Mounting of dispensers.** Dispensing devices except those installed on top of a protected above-ground tank that qualifies as vehicle-impact resistant, shall be protected against physical damage by mounting on a concrete island 152 mm or more in height, or shall otherwise be suitably protected in accordance with Chapter 5. Dispensing devices shall be installed and securely fastened to their mounting surface in accordance with the dispenser manufacturer's instructions. Dispensing devices installed indoors shall be located in an approved position where they cannot be struck by an out-of-control vehicle descending a ramp or other slope.
- 20.6.7.4 Dispenser emergency valve.** An approved emergency shutoff valve designed to close automatically in the event of a fire or impact shall be properly installed in the liquid supply line at the base of each dispenser supplied by a remote pump. The valve shall be installed so that the shear groove is flush with or within 12.7 mm of the top of the concrete dispenser island and there is clearance provided for maintenance purposes around the valve body and operating parts. The valve shall be installed at the liquid supply line inlet of each overhead-type dispenser. Where installed, a vapor return line located inside the dispenser housing shall have a shear section or approved flexible connector for the liquid supply line emergency shutoff valve to function. Emergency shutoff valves shall be installed and maintained in accordance with the manufacturer's instructions, tested at the time of initial installation and tested at least yearly thereafter in accordance with Section 20.5.2.2.
- 20.6.7.5 Dispenser hose.** Dispenser hoses shall be a maximum of 5.5 m in length unless otherwise approved. Dispenser hoses shall be listed and approved. When not in use, hoses shall be reeled, racked or otherwise protected from damage.
- 20.6.7.5.1 Breakaway devices.** Dispenser hoses for Class I and II liquids shall be equipped with a listed emergency breakaway device designed to retain liquid on both sides of a breakaway point. Such devices shall be installed and maintained in accordance with the manufacturer's instructions. Where hoses are attached to hose-retrieving mechanisms, the emergency breakaway device shall be located between the hose nozzle and the point of attachment of the hose-retrieval mechanism to the hose.
- 20.6.7.6 Fuel delivery nozzles.** A listed automatic-closing-type hose nozzle valve with or without a latch-open device shall be provided on island-type dispensers used for dispensing Class I, II or IIIA liquids. Overhead-type dispensing units shall be provided with a listed automatic-closing-type hose nozzle valve without a latch-open device.
- Exception:** A listed automatic-closing-type hose nozzle valve with latch-open

device is allowed to be used on overhead-type dispensing units where the design of the system is such that the hose nozzle valve will close automatically in the event the valve is released from a fill opening or upon impact with a driveway.

**20.6.7.6.1 Special requirements for nozzles.** Where dispensing of Class I, II or IIIA liquids is performed, a listed automatic-closing-type hose nozzle valve shall be used incorporating all of the following features:

1. The hose nozzle valve shall be equipped with an integral latch-open device.
2. When the flow of product is normally controlled by devices or equipment other than the hose nozzle valve, the hose nozzle valve shall not be capable of being opened unless the delivery hose is pressurized. If pressure to the hose is lost, the nozzle shall close automatically.

**Exception:** Vapor recovery nozzles incorporating insertion interlock devices designed to achieve shutoff on disconnect from the vehicle fill pipe.

3. The hose nozzle shall be designed such that the nozzle is retained in the fill pipe during the filling operation.
4. The system shall include listed equipment with a feature that causes or requires the closing of the hose nozzle valve before the product flow can be resumed or before the hose nozzle valve can be replaced in its normal position in the dispenser.

**20.6.7.7 Remote pumping systems.** Remote pumping systems for liquid fuels shall comply with Sections 20.6.7.7.1 and 20.6.7.7.2.

**20.6.7.7.1 Leak detection.** Where remote pumps are used to supply fuel dispensers, each pump shall have installed on the discharge side a listed leak detection device that will detect a leak in the piping and dispensers and provide an indication at an approved location. A leak detection device is not required if the piping from the pump discharge to under the dispenser is above ground and visible.

**20.6.7.7.2 Location.** Remote pumps installed above grade, outside of buildings, shall be located not less than 3 m from lines of adjoining property that can be built upon and not less than 1.5 m from any building opening. Where an outside pump location is impractical, pumps are permitted to be installed inside buildings as provided for dispensers in Section 20.1.4 and Chapter 32. Pumps shall be substantially anchored and protected against physical damage.

**20.6.7.8 Gravity and pressure dispensing.** Flammable liquids shall not be dispensed by gravity from tanks, drums, barrels or similar containers. Flammable or combustible liquids shall not be dispensed by a device operating through pressure within a storage tank, drum or container.

**20.6.7.9 Vapor-recovery and vapor-processing systems.** Vapor-recovery and vapor-processing systems shall be in accordance with Section 20.6.7.9.

**20.6.7.9.1 Vapor-balance systems.** Vapor-balance systems shall comply with Sections 20.6.7.9.1.1 through 20.6.7.9.1.5.

**20.6.7.9.1.1 Dispensing devices.** Dispensing devices incorporating provisions for vapor recovery shall be listed and labeled. When existing listed or labeled dispensing devices are modified for vapor recovery, such modifications shall be listed by report by a nationally recognized testing laboratory. The listing by report shall contain a description of the component parts used in the modification and recommended method of installation on specific dispensers. Such report shall be made available on request of the Building code official.

Means shall be provided to shut down fuel dispensing in the event the vapor return line becomes blocked.

**20.6.7.9.1.2 Vapor-return line close off.** An acceptable method shall be provided to close off the vapor return line from dispensers when the product is not being dispensed.

**20.6.7.9.1.3 Piping.** Piping in vapor-balance systems shall be in accordance with Sections 32.3.6, 32.4.2.9 and 32.4.2.11. Nonmetallic piping shall be installed in accordance with the manufacturer's installation instructions.

Existing and new vent piping shall be in accordance with Sections 32.3.6 and 32.4.2. Vapor return piping shall be installed in a manner that drains back to the tank, without sags or traps in which liquid can become trapped. If necessary, because of grade, condensate tanks are allowed in vapor return piping. Condensate tanks shall be designed and installed so that they can be drained without opening.

**20.6.7.9.1.4 Flexible joints and shear joints.** Flexible joints shall be installed in accordance with Section 32.3.6.9.

An approved shear joint shall be rigidly mounted and connected by a union in the vapor return piping at the base of each dispensing device. The shear joint shall be mounted flush with the top of the surface on which the dispenser is mounted.

**20.6.7.9.1.5 Testing.** Vapor return lines and vent piping shall be tested in accordance with Section 32.3.6.3.

**20.6.7.9.2 Vapor-processing systems.** Vapor-processing systems shall comply with Sections 20.6.7.9.2.1 through 20.6.7.9.2.4.

**20.6.7.9.2.1 Equipment.** Equipment in vapor-processing systems, including hose nozzle valves, vapor pumps, flame arresters, fire checks or systems for prevention of flame propagation, controls and vapor-processing equipment, shall be individually listed for the intended use in a specified manner.

Vapor-processing systems that introduce air into the underground piping or storage tanks shall be provided with equipment for prevention of flame propagation that has been tested and listed as suitable for the intended use.

**20.6.7.9.2.2 Location.** Vapor-processing equipment shall be located at or above grade. Sources of ignition shall be located not less than 15.2 m from fuel-transfer areas and not less than 457 mm above tank fill openings and tops of dispenser islands. Vapor-processing units shall be located not less than 3 m from the nearest building or lot line of a property which can be built upon.

**Exception:** Where the required distances to buildings, lot lines or fuel-transfer areas cannot be obtained, means shall be provided to protect equipment against fire exposure. Acceptable means shall include but not be limited to:

1. Approved protective enclosures, which extend at least 457 mm above the equipment, constructed of fire-resistant or noncombustible materials; or
2. Fire protection using an approved water-spray system.

Vapor-processing equipment shall be located a minimum of 6.1 m from dispensing devices. Processing equipment shall be protected against physical damage by guardrails, curbs, protective enclosures or fencing. Where approved protective enclosures are used, approved means shall be provided to ventilate the volume within the enclosure to prevent pocketing of flammable vapors.

Where a down slope exists toward the location of the vapor-processing unit from a fuel-transfer area, the Building code official is authorized to require additional separation by distance and height.

**20.6.7.9.2.3 Installation.** Vapor-processing units shall be securely mounted on concrete, masonry or structural steel supports on concrete or other noncombustible foundations. Vapor-recovery and vapor-processing equipment is allowed to be installed on roofs when approved.

**20.6.7.9.2.4 Piping.** Piping in a mechanical-assist system shall be in accordance with Section 32.3.6.

**SECTION 20.7**  
**LIQUEFIED PETROLEUM GAS MOTOR FUEL-DISPENSING**  
**FACILITIES**

- 20.7.1 General.** Motor fuel-dispensing facilities for liquefied petroleum gas (LP-gas) fuel shall be in accordance with this section and Chapter 36.
- 20.7.2 Approvals.** Storage vessels and equipment used for the storage or dispensing of LP-gas shall be approved or listed in accordance with Sections 20.7.2.1 and 20.7.2.2.
- 20.7.2.1 Approved equipment.** Containers, pressure relief devices (including pressure relief valves), pressure regulators and piping for LP-gas shall be approved.
- 20.7.2.2 Listed equipment.** Hoses, hose connections, vehicle fuel connections, dispensers, LP-gas pumps and electrical equipment used for LP-gas shall be listed.
- 20.7.3 Attendants.** Motor fuel-dispensing operations shall be conducted by qualified attendants or in accordance with Section 20.7.6 by persons trained in the proper handling of LP-gas.
- 20.7.4 Location of dispensing operations and equipment.** In addition to the requirements of Section 20.6.7, the point of transfer for dispensing operations shall be 7.6 m or more from buildings having combustible exterior wall surfaces, buildings having noncombustible exterior wall surfaces that are not part of a 1-hour fire-resistance-rated assembly, or buildings having combustible overhangs, lot lines of property which could be built on, public streets, or sidewalks and railroads; and at least 3 m from driveways and buildings having noncombustible exterior wall surfaces that are part of a fire-resistance-rated assembly having a rating of 1 hour or more.  
**Exception:** The point of transfer for dispensing operations need not be separated from canopies that are constructed in accordance with the SBC 201 and which provide weather protection for the dispensing equipment. LP-gas containers shall be located in accordance with Chapter 36. LP-gas storage and dispensing equipment shall be located outdoors and in accordance with Section 20.6.7.
- 20.7.5 Installation of LP-gas dispensing devices and equipment.** The installation and operation of LP-gas dispensing systems shall be in accordance with Sections 20.7.5.1 through 20.7.5.3 and Chapter 36. LP-gas dispensers and dispensing stations shall be installed in accordance with the manufacturer's specifications and their listing.
- 20.7.5.1 Valves.** A manual shutoff valve and an excess flow-control check valve shall be located in the liquid line between the pump and the dispenser inlet where the dispensing device is installed at a remote location and is not part of a complete storage and dispensing unit mounted on a common base.  
An excess flow-control check valve or an emergency shutoff valve shall be installed in or on the dispenser at the point at which the dispenser hose is connected to the liquid piping. A differential backpressure valve shall be considered equivalent protection.  
A listed shutoff valve shall be located at the discharge end of the transfer hose.
- 20.7.5.2 Hoses.** Hoses and piping for the dispensing of LP-gas shall be provided with hydrostatic relief valves. The hose length shall not exceed 5.5 m. An approved method shall be provided to protect the hose against mechanical damage.

- 20.7.5.3 Vehicle impact protection.** Vehicle impact protection for LP-gas storage containers, pumps and dispensers shall be provided in accordance with Section 20.6.4.
- 20.7.6 Private fueling of motor vehicles.** Self-service LP-gas dispensing systems, including key, code and card lock dispensing systems, shall not be open to the public and shall be limited to the filling of permanently mounted fuel containers on LP-gas powered vehicles.  
In addition to the requirements of Sections 20.5 and 20.6.7, self-service LP-gas dispensing systems shall be in accordance with the following:
1. The system shall be provided with an emergency shutoff switch located within 30.5 m of, but not less than 6.1 m from, dispensers.
  2. The owner of the LP-gas motor fuel-dispensing facility shall provide for the safe operation of the system and the training of users.
- 20.7.7 Overfilling.** LP-gas containers shall not be filled in excess of the fixed outage installed by the manufacturer or the weight stamped on the tank.

## SECTION 20.8 COMPRESSED NATURAL GAS MOTOR FUEL-DISPENSING FACILITIES

- 20.8.1 General.** Motor fuel-dispensing facilities for compressed natural gas (CNG) fuel shall be in accordance with this section and Chapter 28.
- 20.8.2 Approvals.** Storage vessels and equipment used for the storage, compression or dispensing of CNG shall be approved or listed in accordance with Sections 20.8.2.1 and 20.8.2.2.
- 20.8.2.1 Approved equipment.** Containers, compressors, pressure relief devices (including pressure relief valves), and pressure regulators and piping used for CNG shall be approved.
- 20.8.2.2 Listed equipment.** Hoses, hose connections, dispensers, gas detection systems and electrical equipment used for CNG shall be listed. Vehicle-fueling connections shall be listed and labeled.
- 20.8.3 Location of dispensing operations and equipment.** Compression, storage and dispensing equipment shall be located above ground, outside.  
**Exceptions:**
1. Compression, storage or dispensing equipment shall be allowed in buildings of noncombustible construction, as set forth in the SBC requirements, which are unenclosed for three quarters or more of the perimeter.
  2. Compression, storage and dispensing equipment shall be allowed indoors in accordance with Chapter 28.
- 20.8.3.1 Location on property.** In addition to the requirements of Section 20.3.1, compression, storage and dispensing equipment shall be installed as follows:
1. Not beneath power lines.
  2. 3 m or more from the nearest building or lot line which could be built on, public street, sidewalk, or source of ignition.  
**Exception:** Dispensing equipment need not be separated from canopies that are constructed in accordance with the SBC 201 and which provide weather protection for the dispensing equipment.
  3. 7.6 m or more from the nearest rail of any railroad track and 15.2 m or more

from the nearest rail of any railroad main track or any railroad or transit line where power for train propulsion is provided by an outside electrical source such as third rail or overhead catenary.

4. 15.2 m or more from the vertical plane below the nearest overhead wire of a trolley bus line.

**20.8.4 Private fueling of motor vehicles.** Self-service CNG-dispensing systems, including key, code and card lock dispensing systems, shall be limited to the filling of permanently mounted fuel containers on CNG-powered vehicles. In addition to the requirements in Section 20.11, the owner of a self-service CNG motor fuel-dispensing facility shall ensure the safe operation of the system and the training of users.

**20.8.5 Pressure regulators.** Pressure regulators shall be designed and installed or protected so that their operation will not be affected by the elements (cooling or heating), mud or debris. The protection is allowed to be an integral part of the regulator.

**20.8.6 Valves.** Gas piping to equipment shall be provided with a remote, readily accessible manual shutoff valve.

**20.8.7 Emergency shutdown device.** An emergency shutdown device shall be located within 22.9 m of, but not less than 7.6 m from, dispensers, and shall also be provided in the compressor area. Upon activation, the emergency shutdown shall automatically shutoff the power supply to the compressor and close valves between the main gas supply and the compressor and between the storage containers and dispensers.

**20.8.8 Discharge of CNG from motor vehicle fuel storage containers.** The discharge of CNG from motor vehicle fuel cylinders for the purposes of maintenance, cylinder certification, calibration of dispensers or other activities shall be in accordance with Sections 20.8.8.1 through 20.8.8.1.2.

**20.8.8.1 Methods of discharge.** The discharge of CNG from motor vehicle fuel cylinders shall be accomplished through a closed transfer system in accordance with Section 20.8.8.1.1 or an approved method of atmospheric venting in accordance with Section 20.8.8.1.2.

**20.8.8.1.1 Closed transfer system.** A documented procedure that explains the logical sequence for discharging the cylinder shall be provided to the Building code official for review and approval. The procedure shall include what actions the operator will take in the event of a low-pressure or high-pressure natural gas release during the discharging activity. A drawing illustrating the arrangement of piping, regulators and equipment settings shall be provided to the Building code official for review and approval. The drawing shall illustrate the piping and regulator arrangement and shall be shown in spatial relation to the location of the compressor, storage vessels and emergency shutdown devices.

**20.8.8.1.2 Atmospheric venting.** Atmospheric venting of CNG shall comply with Sections 20.8.8.1.2.1 through 20.8.8.1.2.6.

**20.8.8.1.2.1 Plans and specifications.** A drawing illustrating the location of the vessel support, piping, the method of grounding and bonding, and other requirements specified herein shall be provided to the Building code official for review and approval.

**20.8.8.1.2.2 Cylinder stability.** A method of rigidly supporting the vessel during the venting



of CNG shall be provided. The selected method shall provide not less than two points of support and shall prevent the horizontal and lateral movement of the vessel. The system shall be designed to prevent the movement of the vessel based on the highest gas-release velocity through valve orifices at the vessel's rated pressure and volume. The structure or appurtenance shall be constructed of noncombustible materials.

- 20.8.8.1.2.3 Separation.** The structure or appurtenance used for stabilizing the cylinder shall be separated from the site equipment, features and exposures and shall be located in accordance with Table 20.8.8.1.2.3.

**TABLE 20.8.8.1.2.3  
SEPARATION DISTANCE FOR ATMOSPHERIC VENTING OF CNG**

<b>EQUIPMENT OR FEATURE</b>	<b>MINIMUM SEPARATION (meters)</b>
Buildings	7.6
Building openings	7.6
Lot lines	4.6
Public ways	4.6
Vehicles	7.6
CNG compressor and storage vessels	7.6
CNG dispensers	7.6

- 20.8.8.1.2.4 Grounding and bonding.** The structure or appurtenance used for supporting the cylinder shall be grounded in accordance with the SBC 401. The cylinder valve shall be bonded prior to the commencement of venting operations.

- 20.8.8.1.2.5 Vent tube.** A vent tube that will divert the gas flow to atmosphere shall be installed on the cylinder prior to commencement of the venting and purging operation. The vent tube shall be constructed of pipe or tubing materials approved for use with CNG in accordance with Chapter 28.

The vent tube shall be capable of dispersing the gas a minimum of 3 m above grade level. The vent tube shall not be provided with a rain cap or other feature which would limit or obstruct the gas flow.

At the connection fitting of the vent tube and the CNG cylinder, a listed bidirectional detonation flame arrester shall be provided.

- 20.8.8.1.2.6 Signage.** Approved "No Smoking" signs complying with Chapter 5 shall be posted within 3 m of the cylinder support structure or appurtenance. Approved CYLINDER SHALL BE BONDED signs shall be posted on the cylinder support structure or appurtenance.

## **SECTION 20.9 HYDROGEN MOTOR FUEL-DISPENSING AND GENERATION FACILITIES**

- 20.9.1 General.** Hydrogen motor fuel-dispensing and generation facilities shall be in accordance with this section and Chapter 28. Where a fuel-dispensing facility also includes a repair garage, the repair operation shall comply with Section 20.11.

- 20.9.2 Equipment.** Equipment used for the generation, compression, storage or

dispensing of hydrogen shall be designed for the specific application in accordance with Sections 20.9.2.1 through 20.9.2.3.

- 20.9.2.1 Approved equipment.** Storage vessels, containers, pressure vessels, cylinders, pressure relief devices, including pressure valves, hydrogen vaporizers, pressure regulators and piping used for gaseous hydrogen systems shall be designed and constructed in accordance with Section 25.3, NFPA 50A and NFPA 50B.
- 20.9.2.2 Listed equipment.** Hoses, hose connections, compressors, hydrogen generators, dispensers, detection systems and electrical equipment used for hydrogen shall be listed for use with hydrogen. Hydrogen motor fueling connections shall be listed and labeled for use with hydrogen.
- 20.9.2.3 Electrical equipment.** Electrical installations shall be in accordance with the SBC 401.
- 20.9.3 Location on property.** In addition to the requirements of Section 20.3.1, generation, compression, storage and dispensing equipment shall be located in accordance with Sections 20.9.3.1 through Section 20.9.3.4.
- 20.9.3.1 Outdoor exposures.** Outdoor exposures shall require separation from other fuels or equivalent risks to life safety and buildings or public areas in accordance with Table 20.9.3.1.
- Exception:** Closed systems with a hydrogen capacity of 85 m<sup>3</sup> or less at NTP.

**TABLE 20.9.3.1**  
**OUTDOOR MINIMUM SEPARATION FOR GASEOUS HYDROGEN DISPENSERS,**  
**COMPRESSORS, GENERATORS AND STORAGE VESSELS**

OUTDOOR EQUIPMENT OR FEATURE	DISTANCE (meters)
Building—Noncombustible walls, sprinklered or nonsprinklered	3
Building—Combustible walls, sprinklered or nonsprinklered	7.6 <sup>b,c</sup>
Building—Noncombustible walls, 2-hour fire barrier interrupts line of sight	1.5
Offsite sidewalks and on-site/offsite parked vehicles	4.6 <sup>a,b</sup>
Lot line	3 <sup>a</sup>
Air intake openings	7.6 <sup>c</sup>
Wall openings located less than 7.6 m vertically above	6.1 <sup>c</sup>
Wall openings located greater than 7.6 m vertically above	7.6
Outdoor public assembly	7.6 <sup>a</sup>
Ignition source <sup>d</sup>	3
Flammable or combustible liquid storage—Above ground, diked in accordance with Section 32.4.2.9.6	6.1
Flammable or combustible liquid storage—Above ground, not diked	15.2
Flammable or combustible liquid storage—Below ground, vent or fill opening	6.1
Flammable gas storage (nonhydrogen)—Above ground, with common shutoff	7.6
Flammable gas storage (nonhydrogen)—Above ground, no common shutoff	15.2
Combustible waste material (see Section 5A.4.1.1)	15.2
Liquefied hydrogen storage—Distance to buildings, openings, lot lines, public ways and on-site/off-site parked vehicles	7.6 <sup>a</sup>

- Reduction to 1.5 m shall be permitted where a 2-hour fire barrier interrupts the line of sight between the equipment and the exposure. The height of the barrier for vertical tanks shall be no less than one-third of the height of the tank measured vertically, and the length of the wall shall be 1.5 times the maximum diameter of the tank. The height of the barrier for vertical tanks shall be no less than one-third of the height of the tank measured vertically, and the length of the wall shall be 1.5 times the maximum diameter of the tank.
- A reduction to 0 metre shall be permitted for dispensing equipment and vehicles being refueled.
- Measured along the natural and unobstructed line of travel (e.g., around protective walls, around corners of buildings).
- Ignition source. A flame, spark or hot surface capable of igniting flammable vapors or fumes. Such sources include appliance burner ignitors and hot work, such as welding and open flames.
- For storage volume greater than or equal to 425 m<sup>3</sup> at NTP.

**20.9.3.2 Location of dispensing operations and equipment.** Generation, compression, storage and dispensing equipment shall be located outdoors, above ground.

**Exceptions:**

1. Generation, compression, storage or dispensing equipment shall be allowed in buildings of Type I and II construction, as defined in the SBC requirements, which are unenclosed for three quarters or more of the perimeter and constructed in a manner that prevents the accumulation of hydrogen gas.
2. Generation, compression, storage and dispensing equipment shall be allowed indoors in accordance with Chapter 28 and as set forth in the SBC 201.

**20.9.3.3 Canopies.** Dispensing equipment need not be separated from canopies that are constructed in accordance with the SBC 201 and the SBC 501, in a manner that would prevent the accumulation of hydrogen gas.

**20.9.3.4 Overhead lines.** The proximity to overhead lines shall be as follows:

1. Not less than 15.2 m from the vertical plane below the nearest overhead wire of an electric trolley, train or bus line; and
2. Not less than 1.5 m from the vertical plane below the nearest overhead electrical wire.

**20.9.4 Dispensing into motor vehicles at self-service hydrogen motor fuel-dispensing facilities.** Self-service hydrogen motor fuel-dispensing systems, including key, code and card lock dispensing systems, shall be limited to the filling of permanently mounted fuel containers on hydrogen-powered vehicles. In addition to the requirements in Section 20.11, the owner of a self-service hydrogen motor fuel-dispensing facility shall provide for the safe operation of the system through the institution of a fire safety plan submitted in accordance with Section 5B.4, the training of employees and operators who use and maintain the system in accordance with Section 5B.6, and provisions for hazard communication in accordance with Section 5B.7.

**20.9.5 Safety precautions.** Safety precautions at hydrogen motor fuel-dispensing and generation facilities shall be in accordance with Sections 20.5.1 through 20.5.4.3.

**20.9.5.1 Valves.** Piping to equipment shall be provided with a readily accessible manual shutoff valve that is readily identifiable.

**20.9.5.2 Protection from vehicles.** Guard posts or other approved means shall be provided to protect hydrogen storage systems and use areas subject to vehicular damage in accordance with Section 5A.12.

**20.9.5.3 Emergency shutdown.** An emergency shutdown device shall be located within 22.9 m of, but not less than 7.6 m from, dispensers and hydrogen generators, and shall also be provided in the compressor area. On activation, emergency shutdown shall automatically shutoff the power supply to all hydrogen storage, compression, dispensing and generating equipment, shutoff natural gas or other fuel supply to the hydrogen generator, and close valves between the main supply and the compressor and between the storage containers and dispensing equipment.

**20.9.5.4 Emergency venting of hydrogen systems.** Hydrogen systems shall be equipped with venting that will relieve excessive internal pressure. Hydrogen systems shall not discharge inside buildings. All portions of the system shall be protected by pressure-relieving devices.

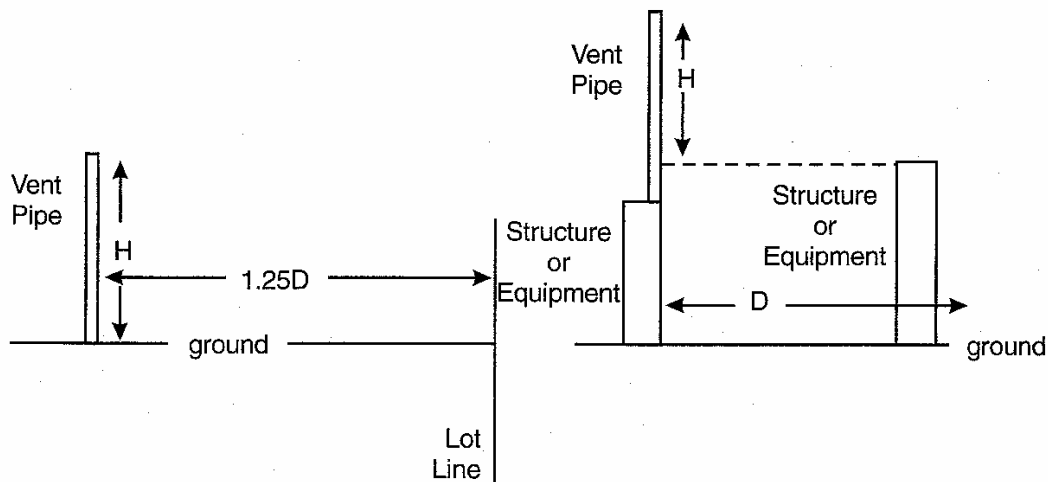
**20.9.5.4.1 Vent pipe.** A vent pipe that will divert the gas flow to atmosphere shall be installed on the vessel for purging operations. The vent pipe shall be designed and constructed as follows:

1. The piping shall be constructed of pipe or tubing materials approved for hydrogen service in accordance with ANSI B31.3 for the rated pressure, volume and temperature. The vent piping shall be designed for the maximum back pressure within the pipe, but not less than 2,310 kPa.
2. The vent pipe shall be properly supported and shall be provided with a rain cap or other feature which would not limit or obstruct the gas flow from venting vertically upward.
3. A means shall be provided to prevent water, ice and other debris from accumulating inside the vent pipe or obstructing the vent pipe.
4. At the connection fitting of the vent pipe and the hydrogen cylinder, a listed bidirectional detonation flame arrester shall be provided.

**TABLE 20.9.5.4.1**  
**VENT PIPE HEIGHT AND SEPARATION DISTANCE VERSUS HYDROGEN FLOW RATE AND VENT PIPE DIAMETER<sup>a,b,c,d,e,f</sup>**

HYDROGEN FLOW RATE	0-500 CFM at NTP		500-1000 CFM at NTP		1,000-2,000 CFM at NTP		2,000-5,000 CFM at NTP			5,000-10,000 CFM at NTP			10,000-20,000 CFM at NTP	
Vent Diameter mm (inches)	25 (1)	50 (2)	25 (1)	50 (2)	25 (1)	50 (2)	25 (1)	50 (2)	80 (3)	25 (1)	50 (2)	80 (3)	50 (2)	80 (3)
Height (m)	2.4	2.4	2.4	2.4	3.7	3.7	5.2	3.7	4	7.6	7.6	6.7	11	11
Distance (m)	4	4	4.6	5.2	6.7	7.9	12	11	12	16.2	16.2	16.2	24.7	24.7

- a. Minimum distance to lot line is 1.25 times the separation distance.
- b. Designs seeking to achieve greater heights with commensurate reductions in separation distances shall be designed in accordance with accepted engineering practice.
- c. With this table, personnel on the ground or on the building/equipment are exposed to a maximum of, and are assumed to be provided with a means to escape to a shielded area within 3 minutes, including the case of a wind.
- d. Designs seeking to achieve greater radiant exposures to noncombustible equipment shall be designed in accordance with accepted engineering practice.
- e. The analysis reflected in this table does not permit hydrogen air mixtures that would exceed one-half of the lower flammable limit (LFL) for hydrogen (2 percent by volume) at the building or equipment, including the case of a wind.
- f. See Figure 20.9.5.4.1.



H = Minimum height in metre of vent pipe above the ground or above any structure or equipment within distance (D) where personnel might be present.

D = Distance in metre to adjacent structure or equipment where personnel might be present.

**FIGURE 20.9.5.4.1**  
**HYDROGEN VENT PIPE HEIGHT (H) VERSUS DISTANCE (D) REQUIREMENTS**

**20.9.5.4.2 Venting of hydrogen gas.** Venting of hydrogen gas shall be as follows:

1. The height ( $H$ ) and separation distance ( $D$ ) of the vent pipe shall meet the criteria set forth in Table 20.9.5.4.1 for the combinations of maximum hydrogen flow rates and vent stack opening diameters listed;
2. The maximum emergency purging flow rate shall be specified for verification by the authority having jurisdiction. The maximum emergency purging flow rate shall be the pressure relief device release rate in accordance with CGA S-1.3 for a nonengulfing flame or the maximum on-site production rate, whichever is larger; or
3. Where alternative venting arrangements are proposed, an analysis of radiant heat exposures shall be provided showing [in a 9.14 m/sec wind]: exposures to employees are limited to no more than 4,732 W/m<sup>2</sup> for a maximum of three minutes, exposures to noncombustible equipment are limited to no more than 25,237 W/m<sup>2</sup>, exposures simulated at the property line are limited to no more than 1,577 W/m<sup>2</sup>; and that no equipment or personnel within  $D$  or  $H$ , or any property line within 1.25  $D$  would be exposed to more than one-half of the lower flammable limit (LFL) for hydrogen (2 percent by volume).

**20.9.5.4.2.1 Minimum rate of discharge.** The minimum rate of discharge of pressure relief devices on the hydrogen storage tanks shall be in accordance with CGA S-1.3, except for the provision in Section 20.9.5.4.3, or the ASME Boiler and Pressure Vessel Code, as applicable.**20.9.5.4.3 Vent pipe flow rates.** Where above-ground storage of flammable or combustible liquids occurs and the tanks are diked, or no above-ground storage of flammable or combustible liquids exists, the sizing of the maximum flow for the vent pipe need not include the vent flow as a result of an “engulfing fire” of the hydrogen storage tanks. The pressure relief valve(s) on the gaseous hydrogen storage tanks shall be sized to accommodate a hydrogen compressor that fails to shutdown or unload as a minimum.

## SECTION 20.10

### MARINE MOTOR FUEL-DISPENSING FACILITIES

**20.10.1 General.** The construction of marine motor fuel-dispensing facilities shall be in accordance with the SBC 201 and NFPA 30A. The storage of Class I, II or IIIA liquids at marine motor fuel-dispensing facilities shall be in accordance with this chapter and Chapter 32.**20.10.2 Storage and handling.** The storage and handling of Class I, II or IIIA liquids at marine motor fuel-dispensing facilities shall be in accordance with Sections 20.10.2.1 through 20.10.2.3.**20.10.2.1 Class I, II or IIIA liquid storage.** Class I, II or IIIA liquids stored inside of buildings used for marine motor fuel-dispensing facilities shall be stored in approved containers or portable tanks. Storage of Class I liquids shall not exceed 38 L.**Exception:** Storage in liquid storage rooms in accordance with Section 32.4.3.7.**20.10.2.2 Class II or IIIA liquid storage and dispensing.** Class II or IIIA liquids stored or dispensed inside of buildings used for marine motor fuel-dispensing facilities shall be stored in and dispensed from approved containers or portable tanks. Storage of Class II and IIIA liquids shall not exceed 454 L.**20.10.2.3 Heating equipment.** Heating equipment installed in Class I, II or IIIA liquid storage or dispensing areas shall comply with Section 20.1.6.

- 20.10.3 Dispensing.** The dispensing of liquid fuels at marine motor fuel-dispensing facilities shall comply with Sections 20.10.3.1 through 20.10.3.5.
- 20.10.3.1 General.** Wharves, piers or floats at marine motor fuel-dispensing facilities shall be used exclusively for the dispensing or transfer of petroleum products to or from marine craft, except that transfer of essential ship stores is allowed.
- 20.10.3.2 Supervision.** Marine motor fuel-dispensing facilities shall have an attendant or supervisor who is fully aware of the operation, mechanics and hazards inherent to fueling of boats on duty whenever the facility is open for business. The attendant's primary function shall be to supervise, observe and control the dispensing of Class I, II or IIIA liquids or flammable gases.
- 20.10.3.3 Hoses and nozzles.** Dispensing of Class I, II or IIIA liquids into the fuel tanks of marine craft shall be by means of an approved-type hose equipped with a listed automatic-closing nozzle without a latch-open device.  
Hoses used for dispensing or transferring Class I, II or IIIA liquids, when not in use, shall be reeled, racked or otherwise protected from mechanical damage.
- 20.10.3.4 Portable containers.** Class I, II or IIIA liquids shall not be dispensed into a portable container unless such container is approved.
- 20.10.3.5 Liquefied petroleum gas.** Liquefied petroleum gas cylinders shall not be filled at marine motor fuel-dispensing facilities unless approved. Approved storage facilities for LP-gas cylinders shall be provided. See also Section 20.7.
- 20.10.4 Fueling of marine vehicles at other than approved marine motor fuel-dispensing facilities.** Fueling of floating marine craft with Class I fuels at other than a marine motor fuel-dispensing facility is prohibited. Fueling of floating marine craft with Class II or III fuels at other than a marine motor fuel-dispensing facility shall be in accordance with all of the following:
1. The premises and operations shall be approved by the Building code official.
  2. Tank vehicles and fueling operations shall comply with Section 32.6.6.
  3. The dispensing nozzle shall be of the listed automatic-closing type without a latch-open device.
  4. Nighttime deliveries shall only be made in lighted areas.
  5. The tank vehicle flasher lights shall be in operation while dispensing.
  6. Fuel expansion space shall be left in each fuel tank to prevent overflow in the event of temperature increase.
- 20.10.5 Fire prevention regulations.** General fire safety regulations for marine motor fuel-dispensing facilities shall comply with Sections 20.10.5.1 through 20.10.5.7.
- 20.10.5.1 Housekeeping.** Marine motor fuel-dispensing facilities shall be maintained in a neat and orderly manner. Accumulations of rubbish or waste oils in excessive amounts shall be prohibited.
- 20.10.5.2 Spills.** Spills of Class I, II or IIIA liquids at or on the water shall be reported immediately to the Civil Defence and jurisdictional authorities.
- 20.10.5.3 Rubbish containers.** Metal containers with tight-fitting or self-closing metal lids shall be provided for the temporary storage of combustible trash or rubbish.
- 20.10.5.4 Marine vessels and craft.** Vessels or craft shall not be made fast to fuel docks serving other vessels or craft occupying a berth at a marine motor fuel-dispensing facility.
- 20.10.5.5 Sources of ignition.** Construction, maintenance, repair and reconditioning work involving the use of open flames, arcs or spark-producing devices shall not be performed at marine motor fuel-dispensing facilities or within 15.2 m of the dispensing facilities, including piers, wharves or floats, except for emergency

repair work approved in writing by the Building code official. Fueling shall not be conducted at the pier, wharf or float during the course of such emergency repairs.

- 20.10.5.5.1 Smoking.** Smoking or open flames shall be prohibited within 15.2 m of fueling operations. “No Smoking” signs complying with Section 5A.10 shall be posted conspicuously about the premises. Such signs shall have letters not less than 102 mm in height on a background of contrasting color.
- 20.10.5.6 Preparation of tanks for fueling.** Boat owners and operators shall not offer their craft for fueling unless the tanks being filled are properly vented to dissipate fumes to the outside atmosphere.
- 20.10.5.7 Warning signs.** Warning signs shall be prominently displayed at the face of each wharf, pier or float at such elevation as to be clearly visible from the decks of marine craft being fueled. Such signs shall have letters not less than 76 mm in height on a background of contrasting color bearing the following or approved equivalent wording:

**WARNING**

NO SMOKING – STOP ENGINE WHILE FUELING,  
SHUTOFF ELECTRICITY. DO NOT START ENGINE  
UNTIL AFTER BELOW DECK SPACES ARE  
VENTILATED.

- 20.10.6 Fire protection.** Fire protection features for marine motor fuel-dispensing facilities shall comply with Sections 20.10.6.1 through 20.10.6.4.
- 20.10.6.1 Standpipe hose stations.** Fire hose, where provided, shall be enclosed within a cabinet, and hose stations shall be labeled: FIRE HOSE – EMERGENCY USE ONLY.
- 20.10.6.2 Obstruction of fire protection equipment.** Materials shall not be placed on a pier in such a manner as to obstruct access to fire-fighting equipment or piping system control valves.
- 20.10.6.3 Access.** Where the pier is accessible to vehicular traffic, an unobstructed roadway to the shore end of the wharf shall be maintained for access by fire apparatus.
- 20.10.6.4 Portable fire extinguishers.** Portable fire extinguishers in accordance with Section 7.6, each having a minimum rating of 20-B:C, shall be provided as follows:
1. One on each float.
  2. One on the pier or wharf within 7.6 m of the head of the gangway to the float, unless the office is within 7.6 m of the gangway or is on the float and an extinguisher is provided thereon.

## **SECTION 20.11 REPAIR GARAGES**

- 20.11.1 General.** Repair garages shall comply with this section and the SBC requirements. Repair garages for vehicles that use more than one type of fuel shall comply with the applicable provisions of this section for each type of fuel used. Where a repair garage also includes a motor fuel-dispensing facility, the fuel-dispensing operation shall comply with the requirements of this chapter for motor fuel-dispensing facilities.
- 20.11.2 Storage and use of flammable and combustible liquids.** The storage and use of flammable and combustible liquids in repair garages shall comply with Chapter 32 and Sections 20.11.2.1 through 20.11.2.4.

- 20.11.2.1 Cleaning of parts.** Cleaning of parts shall be conducted in listed and approved parts-cleaning machines in accordance with Chapter 32.
- 20.11.2.2 Waste oil, motor oil and other Class IIIB liquids.** Waste oil, motor oil and other Class IIIB liquids shall be stored in approved tanks or containers, which are allowed to be stored and dispensed from inside repair garages. Tanks storing Class IIIB liquids in repair garages are allowed to be located at, below or above grade, provided that adequate drainage or containment is provided. Crankcase drainings shall be classified as Class IIIB liquids unless otherwise determined by testing.
- 20.11.2.3 Drainage and disposal of liquids and oil-soaked waste.** Garage floor drains, where provided, shall drain to approved oil separators or traps discharging to a sewer in accordance with the SBC 701. Contents of oil separators, traps and floor drainage systems shall be collected at sufficiently frequent intervals and removed from the premises to prevent oil from being carried into the sewers. Crankcase drainings and liquids shall not be dumped into sewers, streams or on the ground, but shall be stored in approved tanks or containers in accordance with Chapter 32 until removed from the premises. Self-closing metal cans shall be used for oily waste.
- 20.11.2.4 Spray finishing.** Spray finishing with flammable or combustible liquids shall comply with Chapter 12.
- 20.11.3 Sources of ignition.** Sources of ignition shall not be located within 457 mm of the floor and shall comply with Chapters 5 and 24.
- 20.11.3.1 Equipment.** Appliances and equipment installed in a repair garage shall comply with the provisions of the SBC 201, the SBC 501 and the SBC 401.
- 20.11.3.2 Smoking.** Smoking shall not be permitted in repair garages except in approved locations complying with Section 5A.10.
- 20.11.4 Below-grade areas.** Pits and below-grade work areas in repair garages shall comply with Sections 20.11.4.1 through 20.11.4.4.
- 20.11.4.1 Construction.** Pits and below-grade work areas shall be constructed in accordance with the SBC 201 requirements.
- 20.11.4.2 Means of egress.** Pits and below-grade work areas shall be provided with means of egress in accordance with Chapter 8.
- 20.11.4.3 Ventilation.** Where Class I liquids or LP-gas are stored or used within a building having a basement or pit wherein flammable vapors could accumulate, the basement or pit shall be provided with mechanical ventilation in accordance with the SBC 501, at a minimum rate of  $0.008 \text{ m}^3/(\text{s}\cdot\text{m}^2)$  to prevent the accumulation of flammable vapors.
- 20.11.5 Preparation of vehicles for repair.** For vehicles powered by gaseous fuels, the fuel shutoff valves shall be closed prior to repairing any portion of the vehicle fuel system. Vehicles powered by gaseous fuels in which the fuel system has been damaged shall be inspected and evaluated for fuel system integrity prior to being brought into the repair garage. The inspection shall include testing of the entire fuel delivery system for leakage.
- 20.11.6 Fire extinguishers.** Fire extinguishers shall be provided in accordance with Section 7.6.



- 20.11.7 Repair garages for vehicles fueled by lighter-than-air fuels.** Repair garages for the conversion and repair of vehicles which use CNG, liquefied natural gas (LNG), hydrogen or other lighter-than-air motor fuels shall be in accordance with Section 20.11.7 in addition to the other requirements of Section 20.11.
- Exception:** Repair garages where work is not performed on the fuel system and is limited to exchange of parts and maintenance requiring no open flame or welding.
- 20.11.7.1 Ventilation.** Repair garages used for the repair of natural gas or hydrogen-fueled vehicles shall be provided with an approved mechanical ventilation system. The mechanical ventilation system shall be in accordance with the SBC 501 and Sections 20.11.7.1.1 and 20.11.7.1.2.
- Exception:** Repair garages with natural ventilation when approved.
- 20.11.7.1.1 Design.** Indoor locations shall be ventilated utilizing air supply inlets and exhaust outlets arranged to provide uniform air movement to the extent practical. Inlets shall be uniformly arranged on exterior walls near floor level. Outlets shall be located at the high point of the room in exterior walls or the roof.
- Ventilation shall be by a continuous mechanical ventilation system or by a mechanical ventilation system activated by a continuously monitoring natural gas detection system where a gas concentration of not more than 25 percent of the lower flammable limit (LFL) is present. In either case, the system shall shut down the fueling system in the event of failure of the ventilation system.
- The ventilation rate shall be at least  $0.00139 \text{ m}^3/\text{s}\cdot\text{m}^2$  of room volume.
- 20.11.7.1.2 Operation.** The mechanical ventilation system shall operate continuously.
- Exceptions:**
1. Mechanical ventilation systems that are interlocked with a gas detection system designed in accordance with Section 20.11.7.2.
  2. Mechanical ventilation systems in repair garages that are used only for repair of vehicles fueled by liquid fuels or odorized gases, such as CNG, where the ventilation system is electrically interlocked with the lighting circuit.
- 20.11.7.2 Gas detection system.** Repair garages used for repair of vehicles fueled by nonodorized gases, such as hydrogen and nonodorized LNG, shall be provided with an approved flammable gas detection system.
- 20.11.7.2.1 System design.** The flammable gas detection system shall be calibrated to the types of fuels or gases used by vehicles to be repaired. The gas detection system shall be designed to activate when the level of flammable gas exceeds 25 percent of the lower flammable limit (LFL). Gas detection shall also be provided in lubrication or chassis repair pits of repair garages used for repairing nonodorized LNG-fueled vehicles.
- 20.11.7.2.2 Operation.** Activation of the gas detection system shall result in all the following:
1. Initiation of distinct audible and visual alarm signals in the repair garage.
  2. Deactivation of all heating systems located in the repair garage.
  3. Activation of the mechanical ventilation system, when the system is interlocked with gas detection.
- 20.11.7.2.3 Failure of the gas detection system.** Failure of the gas detection system shall result in the deactivation of the heating system, activation of the mechanical ventilation system and where the system is interlocked with gas detection and causes a trouble signal to sound in an approved location.
- 20.11.8 Defueling of hydrogen from motor vehicle fuel storage containers.** The discharge or defueling of hydrogen from motor vehicle fuel storage tanks for the purpose of maintenance, cylinder certification, calibration of dispensers or other activities shall be in accordance with Section 20.10.8.1.

- 20.11.8.1 Methods of discharge.** The discharge of hydrogen from motor vehicle fuel storage tanks shall be accomplished through a closed transfer system in accordance with Section 20.10.8.1.1 or an approved method of atmospheric venting in accordance with Section 20.10.8.1.2.
- 20.11.8.1.1 Closed transfer system.** A documented procedure that explains the logic sequence for discharging the storage tank shall be provided to the code official for review and approval. The procedure shall include what actions the operator is required to take in the event of a low-pressure or high-pressure hydrogen release during discharging activity. Schematic design documents shall be provided illustrating the arrangement of piping, regulators and equipment settings. The construction documents shall illustrate the piping and regulator arrangement and shall be shown in spatial relation to the location of the compressor, storage vessels and emergency shutdown devices.
- 20.11.8.1.2 Atmospheric venting of hydrogen from motor vehicle fuel storage containers.** When atmospheric venting is used for the discharge of hydrogen from motor vehicle fuel storage tanks, such venting shall be in accordance with Sections 20.10.8.1.2.1 through 20.10.8.1.2.4.
- 20.11.8.1.2.1 Defueling equipment required at vehicle maintenance and repair facilities.** All facilities for repairing hydrogen systems on hydrogen-fueled vehicles shall have equipment to defuel vehicle storage tanks. Equipment used for defueling shall be listed and labeled for the intended use.
- 20.11.8.1.2.1.1 Manufacturer's equipment required.** Equipment supplied by the vehicle manufacturer shall be used to connect the vehicle storage tanks to be defueled to the vent pipe system.
- 20.11.8.1.2.1.2 Vent pipe maximum diameter.** Defueling vent pipes shall have a maximum inside diameter of 25 mm and be installed in accordance with Section 20.9.5.4.
- 20.11.8.1.2.1.3 Maximum flow rate.** The maximum rate of hydrogen flow through the vent pipe system shall not exceed at NTP 2.5 kg/min and shall be controlled by means of the manufacturer's equipment, at low pressure and without adjustment.
- 20.11.8.1.2.1.4 Isolated use.** The vent pipe used for defueling shall not be connected to another venting system used for any other purpose.
- 20.11.8.1.2.2 Construction documents.** Construction documents shall be provided illustrating the defueling system to be utilized. Plan details shall be of sufficient detail and clarity to allow for evaluation of the piping and control systems to be utilized and include the method of support for cylinders, containers or tanks to be used as part of a closed transfer system, the method of grounding and bonding, and other requirements specified herein.
- 20.11.8.1.2.3 Stability of cylinders, containers and tanks.** A method of rigidly supporting cylinders, containers or tanks used during the closed transfer system discharge or defueling of hydrogen shall be provided. The method shall provide not less than two points of support and shall be designed to resist lateral movement of the receiving cylinder, container or tank. The system shall be designed to resist movement of the receiver based on the highest gas-release velocity through valve orifices at the receiver's rated service pressure and volume. Supporting structure or appurtenance used to support receivers shall be constructed of noncombustible materials in accordance with the SBC requirements.
- 20.11.8.1.2.4 Grounding and bonding.** Cylinders, containers or tanks and piping systems used for defueling shall be bonded and grounded. Structures or appurtenances used for supporting the cylinders, containers or tanks shall be grounded in accordance with the SBC 401. The valve of the vehicle storage tank shall be bonded with the defueling system prior to the commencement of discharge or defueling operations.

- 20.11.8.2 Repair of hydrogen piping.** Piping systems containing hydrogen shall not be opened to the atmosphere for repair without first purging the piping with an inert gas to achieve 1 percent hydrogen or less by volume. Defueling operations and exiting purge flow shall be vented in accordance with Section 20.10.8.1.2.
- 20.11.8.3 Purging.** Each individual manufactured component of a hydrogen generating, compression, storage or dispensing system shall have a label affixed as well as a description in the installation and owner's manuals describing the procedure for purging air from the system during startup, regular maintenance and for purging hydrogen from the system prior to disassembly (to admit air).  
For the interconnecting piping between the individual manufactured components, the pressure rating must be at least 20 times the absolute pressure present in the piping when any hydrogen meets any air.
- 20.11.8.3.1 System purge required.** After installation, repair or maintenance, the hydrogen piping system shall be purged of air in accordance with the manufacturer's procedure for purging air from the system.

## CHAPTER 21 HIGH-PILED COMBUSTIBLE STORAGE

### SECTION 21.1 GENERAL

- 21.1.1 Scope.** High-piled combustible storage shall be in accordance with this chapter. In addition to the requirements of this chapter, the following material-specific requirements shall apply:
1. Aerosols shall be in accordance with Chapter 26.
  2. Flammable and combustible liquids shall be in accordance with Chapter 32.
  3. Hazardous materials shall be in accordance with Chapter 25.
  4. Storage of combustible paper records shall be in accordance with NFPA 231C.
  5. Storage of combustible fibers shall be in accordance with Chapter 27.
  6. Storage of miscellaneous combustible material shall be in accordance with Chapter 5.
- 21.1.2 Permits.** A permit shall be required as set forth in SBC 100.
- 21.1.3 Construction documents.** At the time of building permit application for new structures designed to accommodate high-piled storage or for requesting a change of occupancy/use, and at the time of application for a storage permit, plans and specifications shall be submitted for review and approval. In addition to the information required by the SBC 100, the storage permit submittal shall include the information specified in this section. Following approval of the plans, a copy of the approved plans shall be maintained on the premises in an approved location. The plans shall include the following:
1. Floor plan of the building showing locations and dimensions of high-piled storage areas.
  2. Usable storage height for each storage area.
  3. Number of tiers within each rack, if applicable.
  4. Commodity clearance between top of storage and the sprinkler deflector for each storage arrangement.
  5. Aisle dimensions between each storage array.
  6. Maximum pile volume for each storage array.
  7. Location and classification of commodities in accordance with Section 21.3.
  8. Location of commodities which are banded or encapsulated.
  9. Location of required Civil Defence access doors.
  10. Type of fire suppression and fire detection systems.
  11. Location of valves controlling the water supply of ceiling and in-rack sprinklers.
  12. Type, location and specifications of smoke removal and curtain board systems.
  13. Dimension and location of transverse and longitudinal flue spaces.
  14. Additional information regarding required design features, commodities, storage arrangement and fire protection features within the high-piled storage area shall be provided at the time of permit, when required by the building code official.
- 21.1.4 Evacuation plan.** When required by the building code official, an evacuation plan for public accessible areas and a separate set of plans indicating location and width of aisles, location of exits, exit access doors, exit signs, height of storage, and

locations of hazardous materials shall be submitted at the time of permit application for review and approval. Following approval of the plans, a copy of the approved plans shall be maintained on the premises in an approved location.

## SECTION 21.2 DEFINITIONS

**21.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in the code requirements, have the meanings shown herein.

**ARRAY.** The configuration of storage. Characteristics considered in defining an array include the type of packaging, flue spaces, height of storage and compactness of storage.

**ARRAY, CLOSED.** A storage configuration having a 152 mm or smaller width vertical flue space that restricts air movement through the stored commodity.

**BIN BOX.** A five-sided container with the open side facing an aisle. Bin boxes are self-supporting or supported by a structure designed so that little or no horizontal or vertical space exists around the boxes.

**COMMODITY.** A combination of products, packing materials and containers.

**DRAFT CURTAIN.** A structure arranged to limit the spread of smoke and heat along the underside of the ceiling or roof.

**EARLY SUPPRESSION FAST-RESPONSE (ESFR) SPRINKLER.** A sprinkler listed for early suppression fast-response performance.

**EXPANDED PLASTIC.** A foam or cellular plastic material having a reduced density based on the presence of numerous small cavities or cells dispersed throughout the material.

**EXTRA-HIGH-RACK COMBUSTIBLE STORAGE.** Storage on racks of Class I, II, III or IV commodities which exceed 12.2 m in height and storage on racks of high-hazard commodities which exceed 9.1 m in height.

**HIGH-PILED COMBUSTIBLE STORAGE.** Storage of combustible materials in closely packed piles or combustible materials on pallets, in racks or on shelves where the top of storage is greater than 3.7 m in height. When required by the building code official, high-piled combustible storage also includes certain high-hazard commodities, such as rubber tires, Group A plastics, flammable liquids, idle pallets and similar commodities, where the top of storage is greater than 1.8 m in height.

**HIGH-PILED STORAGE AREA.** An area within a building which is designated, intended, proposed or actually used for high-piled combustible storage.

**LONGITUDINAL FLUE SPACE.** The flue space between rows of storage perpendicular to the direction of loading.

**MANUAL STOCKING METHODS.** Stocking methods utilizing ladders or other

nonmechanical equipment to move stock.

**MECHANICAL STOCKING METHODS.** Stocking methods utilizing motorized vehicles or hydraulic jacks to move stock.

**SHELF STORAGE.** Storage on shelves less than 760 mm deep with the distance between shelves not exceeding 900 mm vertically. For other shelving arrangements, see the requirements for rack storage.

**SOLID SHELVING.** Shelving that is solid, slatted or of other construction located in racks and which obstructs sprinkler discharge down into the racks.

**TRANSVERSE FLUE SPACE.** The space between rows of storage parallel to the direction of loading.

### SECTION 21.3 COMMODITY CLASSIFICATION

**21.3.1 Classification of commodities.** Commodities shall be classified as Class I, II, III, IV or high hazard in accordance with this section. Materials listed within each commodity classification are assumed to be unmodified for improved combustibility characteristics. Use of flame-retarding modifiers or the physical form of the material could change the classification. See Section 21.3.7 for classification of Group A, B and C plastics.

**21.3.2 Class I commodities.** Class I commodities are essentially noncombustible products on wooden or nonexpanded polyethylene solid deck pallets, in ordinary corrugated cartons with or without single-thickness dividers, or in ordinary paper wrappings with or without pallets. Class I commodities are allowed to contain a limited amount of Group A plastics in accordance with Section 21.3.7.4. Examples of Class I commodities include, but are not limited to, the following:

- Alcoholic not exceeding 20 percent alcohol
- Appliances noncombustible, electrical
- Cement in bags
- Ceramics
- Dairy products in nonwax-coated containers (excluding bottles)
- Dry insecticides
- Foods in noncombustible containers
- Fresh fruits and vegetables in nonplastic trays or containers
- Frozen foods
- Glass
- Glycol in metal cans
- Gypsum board
- Inert materials, bagged
- Insulation, noncombustible
- Noncombustible liquids in plastic containers having less than a 19 L
- Noncombustible metal products

**21.3.3 Class II commodities.** Class II commodities are Class I products in slatted wooden crates, solid wooden boxes, multiple-thickness paperboard cartons or equivalent combustible packaging material with or without pallets. Class II commodities are allowed to contain a limited amount of Group A plastics in accordance with

Section 21.3.7.4. Examples of Class II commodities include, but are not limited to, the following:

Alcoholic not exceeding 20 percent alcohol, in combustible containers  
 Foods in combustible containers  
 Incandescent or fluorescent light bulbs in cartons  
 Thinly coated fine wire on reels or in cartons

**21.3.4 Class III commodities.** Class III commodities are commodities of wood, paper, natural fiber cloth, or Group C plastics or products thereof, with or without pallets. Products are allowed to contain limited amounts of Group A or B plastics, such as metal bicycles with plastic handles, pedals, seats and tires. Group A plastics shall be limited in accordance with Section 21.3.7.4. Examples of Class III commodities include, but are not limited to, the following:

Aerosol, Level 1 (see Chapter 26)  
 Combustible fiberboard  
 Cork, baled  
 Feed, bagged  
 Fertilizers, bagged  
 Food in plastic containers  
 Furniture: wood, natural fiber, upholstered, nonplastic, wood or metal with plastic-padded and covered arm rests  
 Glycol in combustible containers not exceeding 25 percent  
 Lubricating or hydraulic fluid in metal cans  
 Lumber  
 Mattresses, excluding foam rubber and foam plastics  
 Noncombustible liquids in plastic containers having a capacity of more than 19 L  
 Paints, oil base, in metal cans  
 Paper, waste, baled  
 Paper and pulp, horizontal storage, or vertical storage that is banded or protected with approved wrap  
 Paper in cardboard boxes  
 Pillows, excluding foam rubber and foam plastics  
 Plastic-coated paper food containers  
 Plywood  
 Rags, baled  
 Rugs, without foam backing  
 Sugar, bagged  
 Wood, baled  
 Wood doors, frames and cabinets  
 Yarns of natural fiber and viscose

**21.3.5 Class IV commodities.** Class IV commodities are Class I, II or III products containing Group A plastics in ordinary corrugated cartons and Class I, II and III products, with Group A plastic packaging, with or without pallets. Group B plastics and free-flowing Group A plastics are also included in this class. The total amount of nonfree-flowing Group A plastics shall be in accordance with Section 21.3.7.4. Examples of Class IV commodities include, but are not limited to, the following:

Aerosol, Level 2 (see Chapter 26)  
 Alcoholic, exceeding 20 percent but less than 80 percent alcohol, in cans or bottles in cartons.  
 Clothing, synthetic or nonviscose  
 Combustible metal products (solid)

Furniture, plastic upholstered  
 Furniture, wood or metal with plastic covering and padding  
 Glycol in combustible containers (greater than 25 percent and less than 50 percent)  
 Linoleum products  
 Paints, oil base in combustible containers  
 Pharmaceutical, alcoholic elixirs, tonics, etc.  
 Rugs, foam back  
 Shingles, asphalt  
 Thread or yarn, synthetic or nonviscose

**21.3.6 High-hazard commodities.** High-hazard commodities are high-hazard products presenting special fire hazards beyond those of Class I, II, III or IV. Group A plastics not otherwise classified are included in this class. Examples of high-hazard commodities include, but are not limited to, the following:

Aerosol, Level 3 (see Chapter 26)  
 Alcoholic, exceeding 80 percent alcohol, in bottles or cartons  
 Commodities of any class in plastic containers in carousel storage  
 Flammable solids (except solid combustible metals)  
 Glycol in combustible containers (50 percent or greater)  
 Lacquers, which dry by solvent evaporation, in metal cans or cartons  
 Lubricating or hydraulic fluid in plastic containers  
 Mattresses, foam rubber or foam plastics  
 Pallets and flats which are idle combustible  
 Paper, asphalt, rolled, horizontal storage  
 Paper, asphalt, rolled, vertical storage  
 Paper and pulp, rolled, in vertical storage which is unbanded or not protected with an approved wrap  
 Pillows, foam rubber and foam plastics  
 Pyroxylin  
 Rubber tires  
 Vegetable oil and butter in plastic containers

**21.3.7 Classification of plastics.** Plastics shall be designated as Group A, B or C in accordance with this section.

**21.3.7.1 Group A plastics.** Group A plastics are plastic materials having a heat of combustion that is much higher than that of ordinary combustibles, and a burning rate higher than that of Group B plastics. Examples of Group A plastics include, but are not limited to, the following:

ABS (acrylonitrile-butadiene-styrene copolymer)  
 Acetal (polyformaldehyde)  
 Acrylic (polymethyl methacrylate)  
 Butyl rubber  
 EPDM (ethylene propylene rubber)  
 FRP (fiberglass-reinforced polyester)  
 Natural rubber (expanded)  
 Nitrile rubber (acrylonitrile butadiene rubber)  
 PET or PETE (polyethylene terephthalate)  
 Polybutadiene  
 Polycarbonate  
 Polyester elastomer  
 Polyethylene  
 Polypropylene



Polystyrene (expanded and unexpanded)

Polyurethane (expanded and unexpanded)

PVC (polyvinyl chloride greater than 15 percent plasticized, e.g., coated fabric unsupported film)

SAN (styrene acrylonitrile)

SBR (styrene butadiene rubber)

- 21.3.7.2 Group B plastics.** Group B plastics are plastic materials having a heat of combustion and a burning rate higher than that of ordinary combustibles, but not as high as those of Group A plastics. Examples of Group B plastics include, but are not limited to, the following:

Cellulosics (cellulose acetate, cellulose acetate butyrate, ethyl cellulose)

Chloroprene rubber

Fluoroplastics (ECTFE, ethylene-chlorotrifluoroethylene copolymer; ETFE, ethylene-tetrafluoroethylene copolymer; FEP, fluorinated ethylene-propylene copolymer)

Natural rubber (nonexpanded)

Nylon (Nylon 6, Nylon 6/6)

PVC (polyvinyl chloride greater than 5-percent, but not exceeding 15 percent plasticized)

Silicone rubber

- 21.3.7.3 Group C plastics.** Group C plastics are plastic materials having a heat of combustion and a burning rate similar to those of ordinary combustibles. Examples of Group C plastics include, but are not limited to, the following:

Fluoroplastics (PCTFE, polychlorotrifluoroethylene; PTFE, polytetrafluoroethylene)

Melamine (melamine formaldehyde)

Phenol

PVC (polyvinyl chloride, rigid or plasticized less than 5 percent, e.g., pipe, pipe fittings)

PVDC (polyvinylidene chloride)

PVDF (polyvinylidene fluoride)

PVF (polyvinyl fluoride)

Urea (urea formaldehyde)

- 21.3.7.4 Limited quantities of Group A plastics in mixed commodities.** Figure 21.3.7.4 shall be used to determine the quantity of Group A plastics allowed to be stored in a package or carton or on a pallet without increasing the commodity classification.

## SECTION 21.4

### DESIGNATION OF HIGH-PILED STORAGE AREAS

- 21.4.1 General.** High-piled storage areas, and portions of high-piled storage areas intended for storage of a different commodity class than adjacent areas, shall be designed and specifically designated to contain Class I, Class II, Class III, Class IV or high-hazard commodities. The designation of a high-piled combustible storage area, or portion thereof intended for storage of a different commodity class, shall be based on the highest hazard commodity class stored except as provided in Section 21.4.2.

- 21.4.2 Designation based on engineering analysis.** The designation of a high-piled combustible storage area, or portion thereof, is allowed to be based on a lower hazard class than that of the highest class of commodity stored when a limited quantity of the higher hazard commodity has been demonstrated by engineering

analysis to be adequately protected by the automatic sprinkler system provided. The engineering analysis shall consider the ability of the sprinkler system to deliver the higher density required by the higher hazard commodity. The higher density shall be based on the actual storage height of the pile or rack and the minimum allowable design area for sprinkler operation as set forth in the density/area figures provided in NFPA 231 and NFPA 231C. The contiguous area occupied by the higher hazard commodity shall not exceed  $11 \text{ m}^2$ , and additional areas of higher hazard commodity shall be separated from other such areas by 7.6 m or more. The sprinkler system shall be capable of delivering the higher density over a minimum area of  $84 \text{ m}^2$  for wet pipe systems and  $111 \text{ m}^2$  for dry pipe systems. The shape of the design area shall be in accordance with Section 7.3.

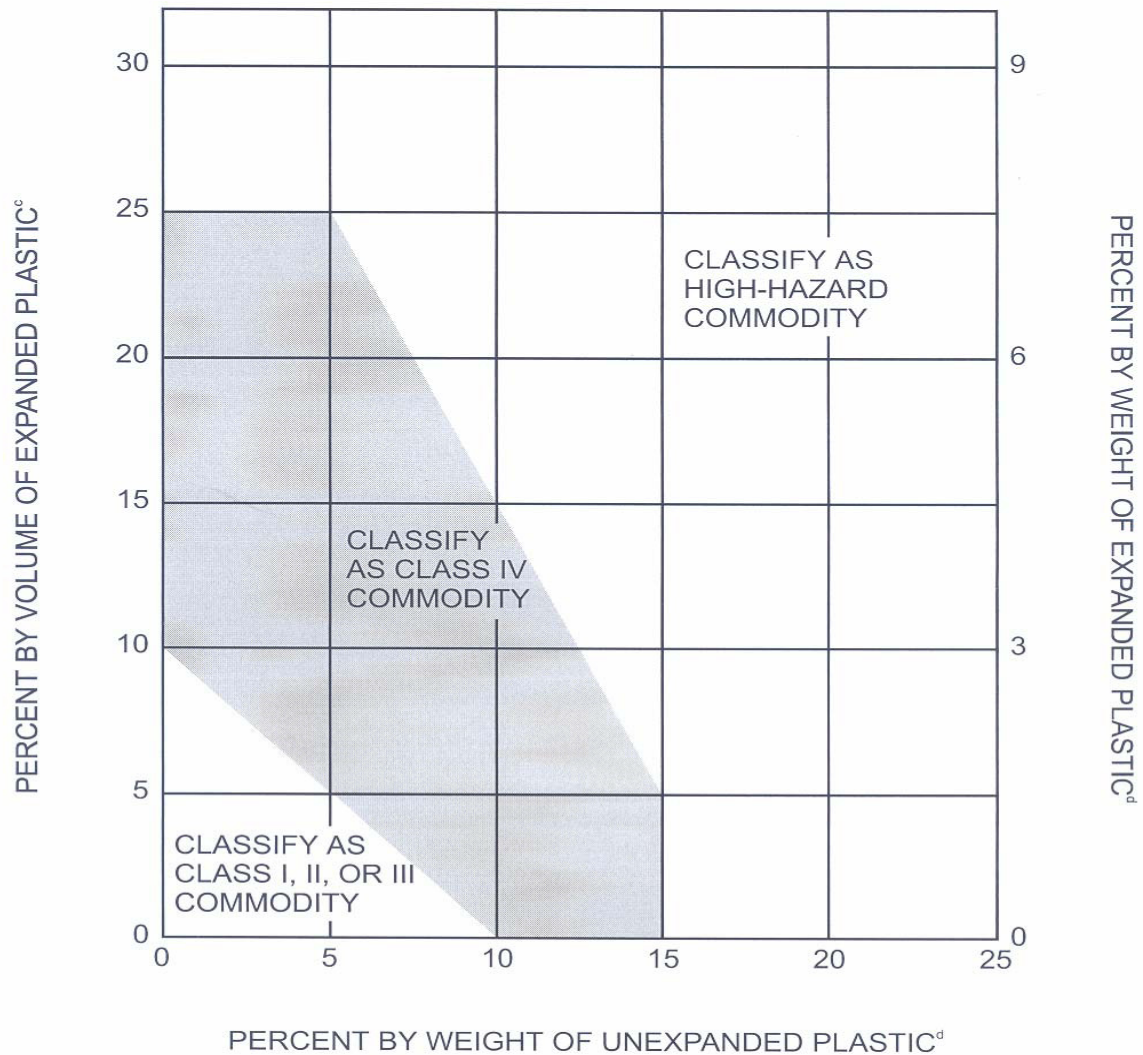
## SECTION 21.5 HOUSEKEEPING AND MAINTENANCE

- 21.5.1 Rack structures.** The structural integrity of racks shall be maintained.
- 21.5.2 Ignition sources.** Clearance from ignition sources shall be provided in accordance with Section 4A.5.
- 21.5.3 Smoking.** Smoking shall be prohibited. Approved “No Smoking” signs shall be conspicuously posted in accordance with Section 4A.10.
- 21.5.4 Aisle maintenance.** When restocking is not being conducted, aisles shall be kept clear of storage, waste material and debris. Civil Defence access doors, aisles and exit doors shall not be obstructed. During restocking operations using manual stocking methods, a minimum unobstructed aisle width of 610 mm shall be maintained in 1.2 m or smaller aisles, and a minimum unobstructed aisle width of one-half of the required aisle width shall be maintained in aisles greater than 1.2 m. During mechanical stocking operations, a minimum unobstructed aisle width of 1.1 m shall be maintained in accordance with Section 21.6.9.
- 21.5.5 Pile dimension and height limitations.** Pile dimensions and height limitations shall comply with Section 21.7.3.
- 21.5.6 Arrays.** Arrays shall comply with Section 21.7.4.
- 21.5.7 Flue spaces.** Flue spaces shall comply with Section 21.8.3.

## SECTION 21.6 GENERAL FIRE PROTECTION AND LIFE SAFETY FEATURES

- 21.6.1 General.** Fire protection and life safety features for high-piled storage areas shall be in accordance with this section.
- 21.6.2 Extent and type of protection.** Where required by Table 21.6.2, fire detection systems, smoke and heat removal, draft curtains and automatic sprinkler design densities shall extend the lesser of 4.6 m beyond the high-piled storage area or to a permanent partition. Where portions of high-piled storage areas have different fire protection requirements because of commodity, method of storage or storage height, the fire protection features required by Table 21.6.2 within this area shall be based on the most restrictive design requirements.

- 21.6.3 Separation of high-piled storage areas.** High-piled storage areas shall be separated from other portions of the building where required by Sections 21.6.3.1 through 21.6.3.2.2.
- 21.6.3.1 Separation from other uses.** Mixed occupancies shall be separated in accordance with the SBC 201.
- 21.6.3.2 Multiple high-piled storage areas.** Multiple high-piled storage areas shall be in accordance with Section 21.6.3.2.1 or 21.6.3.2.2.



**FIGURE 21.3.7.4**  
**MIXED COMMODITIES<sup>a, b</sup>**

- a. This figure is intended to determine the commodity classification of a mixed commodity in a package, carton or on a pallet where plastics are involved.
- b. The following is an example of how to apply the figure: A package containing a Class III commodity has 12 percent Group A expanded plastic by volume. The weight of the unexpanded Group A plastic is 10 percent. This commodity is classified as a Class IV commodity. If the weight of the unexpanded plastic is increased to 14 percent, the classification changes to a high-hazard commodity.
- c. Percent by volume = 
$$\frac{\text{Volume of plastic in pallet load}}{\text{Total volume of pallet load, including pallet}}$$
- d. Percent by weight = 
$$\frac{\text{Weight of plastic in pallet load}}{\text{Total weight of pallet load, including pallet}}$$

**TABLE 21.6.2**  
**GENERAL FIRE PROTECTION AND LIFE SAFETY REQUIREMENTS**

COMMODITY CLASS	SIZE OF HIGH-PILED STORAGE AREA <sup>a</sup> (square meter) (see Sections 21.6.2 and 21.6.4)	ALL STORAGE AREAS (See Sections 21.6, 21.7 and 21.8) <sup>b</sup>					SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (see Section 21.7.3)		
		Automatic fire-extinguishing system (see Section 21.6.4)	Fire detection system (see Section 21.6.5)	Building access (see Section 21.6.6)	Smoke and heat removal (see Section 21.6.7)	Draft curtains (see Section 21.6.7)	Maximum pile dimension <sup>c</sup> (meter)	Maximum permissible storage height <sup>d</sup> (meter)	Maximum pile volume (cubic meter)
I-IV	0-46.5	Not Required <sup>a</sup>	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	Not Required	Not Required	Not Required
	46.6-232.3	Not Required <sup>a</sup>	Yes <sup>i</sup>	Not Required <sup>e</sup>	Not Required	Not Required	30.5	12.2	2,832
	232.4-1,114.8 Public accessible	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	30.5	12.2	11,327
	232.4-1,114.8 Nonpublic accessible (Option 1)	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	30.5	12.2	11,327
	232.4-1,114.8 Nonpublic accessible (Option 2)	Not Required <sup>a</sup>	Yes	Yes	Yes <sup>j</sup>	Yes <sup>j</sup>	30.5	9.1 <sup>f</sup>	5,663
	1,114.9-1,858.1	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	30.5	12.2	11,327
	1,858.2-46,451.5	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	30.5	12.2	11,327
	Greater than 46,451.5 <sup>g</sup>	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	30.5	12.2	11,327
High hazard	0-46.5	Not Required <sup>a</sup>	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	15.2	Not Required	Not Required
	46.6-232.3 Public accessible	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	15.2	9.1	2,124
	46.6-232.3 Nonpublic accessible (Option 1)	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	15.2	9.1	2,124
	46.6-232.3 Nonpublic accessible (Option 2)	Not Required <sup>a</sup>	Yes	Yes	Yes <sup>j</sup>	Yes <sup>j</sup>	15.2	6.1	1,416
	232.4-27,870.9	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	15.2	9.1	2,124
	27,871- 46,451.5 <sup>g,h</sup>	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	15.2	9.1	2,124

- When automatic sprinklers are required for reasons other than those in Chapter 21, the portion of the sprinkler system protecting the high-piled storage area shall be designed and installed in accordance with Sections 21.7 and 21.8.
- For aisles, see Section 21.6.9.
- Piles shall be separated by aisles complying with Section 21.6.9.
- For storage in excess of the height indicated, special fire protection shall be provided in accordance with Note g when required by the building code official. See also Chapters 26 and 32 for special limitations for aerosols and flammable and combustible liquids.
- Section 5A.3 shall apply for fire apparatus access.
- For storage exceeding 9.1 m in height, Option 1 shall be used.
- Special fire protection provisions including, but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional Civil Defence hose connections shall be provided when required by the building code official.
- High-piled storage areas shall not exceed 46,451.5 square meters. A 2-hour fire wall constructed in accordance with these code requirements shall be used to divide high-piled storage exceeding 46,451.5 square meters in area.
- Not required when an automatic fire-extinguishing system is designed and installed to protect the high-piled storage area in accordance with Sections 21.7 and 21.8.
- Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.

- 21.6.3.2.1 Aggregate area.** The aggregate of all high-piled storage areas within a building shall be used for application of Table 21.6.2 unless such areas are separated from each other by 1 hour fire-resistance-rated fire barrier walls constructed in accordance with Chapter 4. Openings in such walls shall be protected by opening protective assemblies having a 1 hour fire protection rating.
- 21.6.3.2.2 Multiclass high-piled storage areas.** High-piled storage areas classified as Class I through Class IV not separated from high-piled storage areas classified as high hazard shall utilize the aggregate of all high-piled storage areas as high hazard for purposes of application of Table 21.6.2. To be considered as separated, 1 hour fire-resistance-rated fire barrier walls shall be constructed in accordance with these code requirements requirements. Openings in such walls shall be protected by opening protective assemblies having a 1 hour fire protection rating.  
**Exception:** As provided for in Section 21.4.2.
- 21.6.4 Automatic sprinklers.** Automatic sprinkler systems shall be provided in accordance with Sections 21.7, 21.8 and 21.9.
- 21.6.5 Fire detection.** Where fire detection is required by Table 21.6.2, an approved automatic fire detection system shall be installed throughout the high-piled storage area. The system shall be monitored and be in accordance with Section 7.7.
- 21.6.6 Building access.** Where building access is required by Table 21.6.2, fire apparatus access roads in accordance with Section 5A.3 shall be provided within 45.7 m of all portions of the exterior walls of buildings used for high-piled storage.  
**Exception:** Where fire apparatus access roads cannot be installed because of topography, railways, waterways, non-negotiable grades or other similar conditions, the building code official is authorized to require additional fire protection.
- 21.6.6.1 Access doors.** Where building access is required by Table 21.6.2, Civil Defence access doors shall be provided in accordance with this section. Access doors shall be accessible without the use of a ladder.
- 21.6.6.1.1 Number of doors required.** A minimum of one access door shall be provided in each 30.5 lineal meter, or fraction thereof, of the exterior walls which face required fire apparatus access roads.
- 21.6.6.1.2 Door size and type.** Access doors shall not be less than 900 mm in width and 2 m in height. Roll-up doors shall not be used unless approved.
- 21.6.6.1.3 Locking devices.** Only approved locking devices shall be used.
- 21.6.7 Smoke and heat removal.** Where smoke and heat removal are required by Table 21.6.1, smoke and heat vents shall be provided in accordance with Section 7.10. Where draft curtains are required by Table 21.6.2, they shall be provided in accordance with Section 7.10.3.4.
- 21.6.8 Civil Defence hose connections.** Where exit passageways are required by these code requirements for egress, a Class I standpipe system shall be provided in accordance with Section 7.5.
- 21.6.9 Aisles.** Aisles providing access to exits and Civil Defence access doors shall be provided in high-piled storage areas exceeding 46 m<sup>2</sup>, in accordance with Sections 21.6.9.1 through 21.6.9.3. Aisles separating storage piles or racks shall comply with NFPA 13. Aisles shall also comply with Chapter 8.  
**Exception:** Where aisles are precluded by rack storage systems, alternate methods of access and protection are allowed when approved.

- 21.6.9.1 Width.** Aisle width shall be in accordance with Sections 21.6.9.1.1 and 21.6.9.1.2.
- Exceptions:**
1. Cross aisles used only for employee access between aisles shall be a minimum of 610 mm wide.
  2. Aisles separating shelves classified as shelf storage shall be a minimum of 760 mm wide.
- 21.6.9.1.1 Sprinklered buildings.** Aisles in sprinklered buildings shall be a minimum of 1.1 m wide. Aisles shall be a minimum of 2.5 m wide in high-piled storage areas exceeding 232 m<sup>2</sup> in area that are accessible to the public and designated to contain high-hazard commodities.
- Exception:** Aisles in high-piled storage areas exceeding 232 m<sup>2</sup> in area, that are accessible to the public and designated to contain high-hazard commodities, are protected by a sprinkler system designed for multiple-row racks of high-hazard commodities shall be a minimum of 1118 mm wide.
- Aisles shall be a minimum of 2.5 m wide in areas accessible to the public where mechanical stocking methods are used.
- 21.6.9.1.2 Nonsprinklered buildings.** Aisles in nonsprinklered buildings shall be a minimum of 2.5 m wide.
- 21.6.9.2 Clear height.** The required aisle width shall extend from floor to ceiling. Rack structural supports and catwalks are allowed to cross aisles at a minimum height of 2.0 m above the finished floor level, provided that such supports do not interfere with Civil Defence hose stream trajectory.
- 21.6.9.3 Dead ends.** Dead-end aisles shall be in accordance with Chapter 8.
- 21.6.10 Portable fire extinguishers.** Portable fire extinguishers shall be provided in accordance with Section 7.6.

## SECTION 21.7 SOLID-PILED AND SHELF STORAGE

- 21.7.1 General.** Shelf storage and storage in solid piles, solid piles on pallets and bin box storage in bin boxes not exceeding 1.5 m in any dimension shall be in accordance with Sections 21.6 and this section.
- 21.7.2 Fire protection.** Where automatic sprinklers are required by Table 21.6.2, an approved automatic sprinkler system shall be installed throughout the building or to 1 hour fire-resistance-rated fire barrier walls constructed in accordance with these code requirements requirements. Openings in such walls shall be protected by opening protective assemblies having 1 hour fire protection ratings. The design and installation of the automatic sprinkler system and other applicable fire protection shall be in accordance with these code requirements and NFPA 231.
- 21.7.2.1 Shelf storage.** Shelf storage greater than 3.7 m but less than 4.6 m in height shall be in accordance with the fire protection requirements set forth in NFPA 231. Shelf storage 4.6 m or more in height shall be protected in an approved manner with special fire protection, such as in-rack sprinklers.
- 21.7.3 Pile dimension and height limitations.** Pile dimensions, the maximum permissible storage height and pile volume shall be in accordance with Table 21.6.2.
- 21.7.4 Array.** Where an automatic sprinkler system design utilizes protection based on a closed array, array clearances shall be provided and maintained as specified by the standard used.

## SECTION 21.8 RACK STORAGE

**21.8.1 General.** Rack storage shall be in accordance with Section 21.6 and this section. Bin boxes exceeding 1.5 m in any dimension shall be regulated as rack storage.

**21.8.2 Fire protection.** Where automatic sprinklers are required by Table 21.6.2, an approved automatic sprinkler system shall be installed throughout the building or to 1 hour fire barrier walls constructed in accordance with these code requirements requirements. Openings in such walls shall be protected by opening protective assemblies having 1 hour fire protection ratings. The design and installation of the automatic sprinkler system and other applicable fire protection shall be in accordance with Section 7.3.3.1.1, these code requirements and NFPA 231C.

**21.8.2.1 Plastic pallets and shelves.** Storage on plastic pallets or plastic shelves shall be protected by approved specially engineered fire protection systems.

**21.8.2.2 Racks with solid shelving.** Racks with solid shelving having an area greater than 3 m<sup>2</sup> measured between approved flue spaces at all four edges of the shelf, shall be in accordance with this section.

**Exceptions:**

1. Racks with mesh, grated, slatted or similar shelves having uniform openings not more than 150 mm apart, comprising at least 50 percent of overall shelf area, and with approved flue spaces, are allowed to be treated as racks without solid shelves.

2. Racks used for the storage of combustible paper records, with solid shelving, shall be in accordance with NFPA 231C.

**21.8.2.2.1 Fire protection.** Fire protection for racks with solid shelving shall be in accordance with NFPA 231C.

**21.8.3 Flue spaces.** Flue spaces shall be provided in accordance with Table 21.8.3. Required flue spaces shall be maintained.

**TABLE 21.8.3  
REQUIRED FLUE SPACES FOR RACK STORAGE**

RACK CONFIGURATION	AUTOMATIC SPRINKLER PROTECTION		SPRINKLER AT THE CEILING WITH OR WITHOUT MINIMUM IN-RACK SPRINKLERS			IN-RACK SPRINKLERS AT EVERY TIER	NONSPRINKLERED
			≤ 7.6 meters		≥ 7.6 meters		
	Storage height		Option 1	Option 2		Any height	Any height
Single-row rack	Transverse flue space	Size <sup>b</sup>	76 mm	Not Applicable	76 mm	Not Required	Not Required
		Vertically aligned	Not Required	Not Applicable	Yes	Not Applicable	Not Required
	Longitudinal flue space		Not Required	Not Applicable	Not Required	Not Required	Not Required
Double-row rack	Transverse flue space	Size <sup>b</sup>	152 mm <sup>a</sup>	76 mm	76 mm	Not Required	Not Required
		Vertically aligned	Not Required	Not Required	Yes	Not Applicable	Not Required
	Longitudinal flue space		Not Required	152 mm	152 mm	Not Required	Not Required
Multi-row rack	Transverse flue space	Size <sup>b</sup>	152 mm	Not Applicable	152 mm	Not Required	Not Required
		Vertically aligned	Not Required	Not Applicable	Yes	Not Applicable	Not Required
	Longitudinal flue space		Not Required	Not Applicable	Not Required	Not Required	Not Required

- a. 76 mm transverse flue spaces shall be provided at least every 3 m where ESFR sprinkler protection is provided.  
b. Random variations are allowed, provided that the configuration does not obstruct water penetration.

- 21.8.4 Column protection.** Steel building columns shall be protected in accordance with NFPA 231C.
- 21.8.5 Extra-high-rack storage systems.** Approval of the building code official shall be obtained prior to installing extra-high-rack combustible storage.
- 21.8.5.1 Fire protection.** Buildings with extra-high-rack combustible storage shall be protected with a specially engineered automatic sprinkler system. Extra-high-rack combustible storage shall be provided with additional special fire protection, such as separation from other buildings and additional built-in fire protection features and Civil Defence access, when required by the building code official.

## SECTION 21.9 AUTOMATED STORAGE

- 21.9.1 General.** Automated storage shall be in accordance with this section.
- 21.9.2 Automatic sprinklers.** Where automatic sprinklers are required by Table 21.6.2, an approved automatic sprinkler system shall be installed throughout the building. The design and installation of the automatic sprinkler system shall be in accordance with Section 7.3.
- 21.9.3 Carousel storage.** High-piled storage areas having greater than 46 m<sup>2</sup> of carousel storage shall be provided with automatic shutdown in accordance with one of the following:
- 1.** An automatic smoke detection system installed in accordance with Section 7.7, with coverage extending 4.6 m in all directions beyond unenclosed carousel storage systems and which sounds a local alarm at the operator's station and stops the carousel storage system upon the activation of a single detector.
  - 2.** An automatic smoke detection system installed in accordance with Section 7.7 and within enclosed carousel storage systems, which sounds a local alarm at the operator's station and stops the carousel storage system upon the activation of a single detector.
  - 3.** A single dead-man-type control switch that allows the operation of the carousel storage system only when the operator is present. The switch shall be in the same room as the carousel storage system and located to provide for observation of the carousel system.

## SECTION 21.10 SPECIALTY STORAGE

- 21.10.1 General.** Records storage facilities used for the rack or shelf storage of combustible paper records greater than 3.7 m in height shall be in accordance with Sections 21.6 and 21.8 and NFPA 231C. Palletized storage of records shall be in accordance with Section 21.7.





## CHAPTER 22

### TENTS, CANOPIES AND OTHER MEMBRANE STRUCTURES

#### SECTION 22.1

##### GENERAL

- 22.1.1 Scope.** Tents, canopies and membrane structures shall comply with this chapter. The provisions of Section 22.3 are applicable only to temporary membrane structures. The provisions of Section 22.4 are applicable to temporary and permanent membrane structures.

#### SECTION 22.2

##### DEFINITIONS

- 22.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**AIR-SUPPORTED STRUCTURE.** A structure wherein the shape of the structure is attained by air pressure, and occupants of the structure are within the elevated pressure area.

**CANOPY.** A structure, enclosure or shelter constructed of fabric or pliable materials supported by any manner, except by air or the contents it protects, and is open without sidewalls or drops on 75 percent or more of the perimeter.

**MEMBRANE STRUCTURE.** An air-inflated, air-supported, cable or frame-covered structure as defined by the SBC 201 and not otherwise defined as a tent or canopy. See Chapter 4 of the SBC 201.

**TENT.** A structure, enclosure or shelter constructed of fabric or pliable material supported by any manner except by air or the contents that it protects.

#### SECTION 22.3

##### TEMPORARY TENTS, CANOPIES AND MEMBRANE STRUCTURES

- 22.3.1 General.** All temporary tents, canopies and membrane structures shall comply with this section.

- 22.3.2 Approval required.** Tents and membrane structures having an area in excess of 19 m<sup>2</sup> and canopies in excess of 37 m<sup>2</sup> shall not be erected, operated or maintained for any purpose without first obtaining a permit and approval from the building code official.

**Exceptions:**

1. Tents used exclusively for recreational camping purposes.
2. Fabric canopies open on all sides which comply with all of the following:
  - 2.1 Individual canopies having a maximum size of 65 m<sup>2</sup>.
  - 2.2 The aggregate area of multiple canopies placed side by side without a fire break clearance of 3.7 m, not exceeding 65 m<sup>2</sup> total.
  - 2.3 A minimum clearance of 3.7 m to all structures and other tents.

- 22.3.3 Place of assembly.** For the purposes of this chapter, a place of assembly shall

include a circus, carnival, tent show, theater, skating rink, wedding hall or other place of assembly in or under which persons gather for any purpose.

- 22.3.4 Permits.** Permits shall be required as set forth in SBC 100.
- 22.3.5 Use period.** Temporary tents, air-supported, air-inflated or tensioned membrane structures and canopies shall be used for a period of not more than 180 days within a 12-month period on a single premise.
- 22.3.6 Construction documents.** A detailed site and floor plan for tents, canopies or membrane structures with an occupant load of 50 or more shall be provided with each application for approval. The tent, canopy or membrane structure floor plan shall indicate details of the means of egress facilities, seating capacity, arrangement of the seating and location and type of heating and electrical equipment.
- 22.3.7 Inspections.** The entire tent, air-supported, air-inflated or tensioned membrane structure system shall be inspected at regular intervals, but not less than two times per permit use period, by the permittee, owner or agent to determine that the installation is maintained in accordance with this chapter.  
**Exception:** Permit use periods of less than 30 days.
- 22.3.7.1 Inspection report.** When required by the building code official, an inspection report shall be provided and shall consist of maintenance, anchors and fabric inspections.
- 22.3.8 Access, location and parking.** Access location and parking for temporary tents, canopies and membrane structures shall be in accordance with this section.
- 22.3.8.1 Access.** Fire apparatus access roads shall be provided in accordance with Section 5C.3.
- 22.3.8.2 Location.** Tents, canopies or membrane structures shall not be located within 6.1 m of lot lines, buildings, other tents, canopies or membrane structures, parked vehicles or internal combustion engines. For the purpose of determining required distances, support ropes and guy wires shall be considered as part of the temporary membrane structure, tent or canopy.  
**Exceptions:**
1. Separation distance between membrane structures, tents and canopies not used for cooking, is not required when the aggregate floor area does not exceed 1,394 m<sup>2</sup>.
  2. Membrane structures, tents or canopies need not be separated from buildings when all of the following conditions are met:
    - 2.1 The aggregate floor area of the membrane structure, tent or canopy shall not exceed 929 m<sup>2</sup>.
    - 2.2 The aggregate floor area of the building and membrane structure, tent or canopy shall not exceed the allowable floor area including increases as indicated in the SBC 201.
    - 2.3 Required means of egress provisions are provided for both, the building and the membrane structure, tent or canopy, including travel distances.
    - 2.4 Fire apparatus access roads are provided in accordance with Section 5C.3.
- 22.3.8.3 Location of structures in excess of 1,394.0 m<sup>2</sup> in area.** Membrane structures having an area of 1,394.0 m<sup>2</sup> or more shall be located not less than 15.2 m from any other tent or structure as measured from the sidewall of the tent or membrane structure unless joined together by a corridor.

- 22.3.8.4 Connecting corridors.** Tents or membrane structures are allowed to be joined together by means of corridors. Exit doors shall be provided at each end of such corridor. On each side of such corridor and approximately opposite each other, there shall be provided openings not less than 3.7 m wide.
- 22.3.8.5 Fire break.** An unobstructed fire break passageway or fire road not less than 3.7 m wide and free from guy ropes or other obstructions shall be maintained on all sides of all tents, canopies and membrane structures unless otherwise approved by the building code official.
- 22.3.9 Anchorage required.** Tents, canopies or membrane structures and their appurtenances shall be adequately roped, braced and anchored to withstand the elements of weather and prevent against collapsing. Documentation of structural stability shall be furnished to the building code official on request.
- 22.3.10 Temporary air-supported and air-inflated membrane structures.** Temporary air-supported and air-inflated membrane structures shall be in accordance with this section.
- 22.3.10.1 Door operation.** During high winds exceeding 80 km/h or in snow conditions, the use of doors in air-supported structures shall be controlled to avoid excessive air loss. Doors shall not be left open.
- 22.3.10.2 Fabric envelope design and construction.** Air-supported and air-inflated structures shall have the design and construction of the fabric envelope and the method of anchoring in accordance with Architectural Fabric Structures Institute ASI 77.
- 22.3.10.3 Blowers.** An air-supported structure used as a place of assembly shall be furnished with not less than two blowers, each of which has adequate capacity to maintain full inflation pressure with normal leakage. The design of the blower shall be so as to provide integral limiting pressure at the design pressure specified by the manufacturer.
- 22.3.10.4 Auxiliary power.** Places of public assembly for more than 200 persons shall be furnished with either a fully automatic auxiliary engine-generator set capable of powering one blower continuously for 4 hours, or a supplementary blower powered by an internal combustion engine which shall be automatic in operation.
- 22.3.11 Seating arrangements.** Seating in tents, canopies or membrane structures shall be in accordance with Chapter 8.
- 22.3.12 Means of egress.** Means of egress for temporary tents, canopies and membrane structures shall be in accordance with this section.
- 22.3.12.1 Distribution.** Exits shall be spaced at approximately equal intervals around the perimeter of the tent, canopy or membrane structure, and shall be located such that all points are 30.5 m or less from an exit.
- 22.3.12.2 Number.** Tents, canopies or membrane structures or a usable portion thereof shall have at least one exit and not less than the number of exits required by Table 22.3.12.2. The widths of means of egress required by Table 22.3.12.2 shall be divided approximately equally among the separate means of egress. The total width of means of egress in millimeters shall not be less than the total occupant load served by a means of egress multiplied by 5.1 mm per person.
- 22.3.12.3 Exit openings from tents.** Exit openings from tents shall remain open unless covered by a flame-resistant curtain. The curtain shall comply with the following requirements:
- 1.** Curtains shall be free sliding on a metal support. The support shall be a

minimum of 2.0 m above the floor level at the exit. The curtains shall be so arranged that, when open, no part of the curtain obstructs the exit.

2. Curtains shall be of a color, or colors that contrasts with the color of the tent.

**TABLE 22.3.12.2**  
**MINIMUM NUMBER OF MEANS OF EGRESS AND MEANS OF**  
**EGRESS WIDTHS FROM TEMPORARY MEMBRANE**  
**STRUCTURES, TENTS AND CANOPIES**

OCCUPANT LOAD	MINIMUM NUMBER OF MEANS OF EGRESS	MINIMUM WIDTH OF EACH MEANS OF EGRESS (mm)	MINIMUM WIDTH OF EACH MEANS OF EGRESS (mm)
		Tent or Canopy	Membrane Structure
10 to 199	2	1,829	914
200 to 499	3	1,829	1,829
500 to 999	4	2,438	1,829
1,000 to 1,999	5	3,048	2,438
2,000 to 2,999	6	3,048	2,438
Over 3,000 <sup>a</sup>	7	3,048	2,438

<sup>a</sup>. When the occupant load exceeds 3,000, the total width of means of egress (in millimetres) shall not be less than the total occupant load multiplied by 5.1 mm per person.

**22.3.12.4 Doors.** Exit doors shall swing in the direction of exit travel. To avoid hazardous air and pressure loss in air-supported membrane structures, such doors shall be automatic closing against operating pressures. Opening force at the door edge shall not exceed 7 kg.

**22.3.12.5 Aisle.** The width of aisles without fixed seating shall be in accordance with the following:

1. In areas serving employees only, the minimum aisle width shall be 600 mm but not less than the width required by the number of employees served.
2. In public areas, smooth-surfaced, unobstructed aisles having a minimum width of not less than 1.1 m shall be provided from seating areas, and aisles shall be progressively increased in width to provide, at all points, not less than 300 mm of aisle width for each 50 persons served by such aisle at that point.

**22.3.12.5.1 Arrangement and maintenance.** The arrangement of aisles shall be subject to approval by the building code official and shall be maintained clear at all times during occupancy.

**22.3.12.6 Exit signs.** Exits shall be clearly marked. Exit signs shall be installed at required exit doorways and where otherwise necessary to indicate clearly the direction of egress when the exit serves an occupant load of 50 or more.

**22.3.12.6.1 Exit sign illumination.** Exit signs shall be of an approved self-luminous type or shall be internally or externally illuminated by fixtures supplied in the following manner:

1. Two separate circuits, one of which shall be separate from all other circuits, for occupant loads of 300 or less; or
2. Two separate sources of power, one of which shall be an approved emergency system, shall be provided when the occupant load exceeds 300. Emergency systems shall be supplied from storage batteries or from the on-site generator set and the system shall be installed in accordance with the SBC 401.

- 22.3.12.7 Means of egress illumination.** Means of egress shall be illuminated with light having an intensity of not less than 11 lux at floor level while the structure is occupied. Fixtures required for means of egress illumination shall be supplied from a separate circuit or source of power.
- 22.3.12.8 Maintenance of means of egress.** The required width of exits, aisles and passageways shall be maintained at all times to a public way. Guy wires, guy ropes and other support members shall not cross a means of egress at a height of less than 2.4 m. The surface of means of egress shall be maintained in an approved manner.

#### **SECTION 22.4**

#### **TEMPORARY AND PERMANENT TENTS, CANOPIES AND MEMBRANE STRUCTURES**

- 22.4.1 General.** All tents, canopies and membrane structures, both temporary and permanent, shall be in accordance with this section. Permanent tents, canopies and membrane structures shall also comply with the SBC 201.
- 22.4.2 Flame-resistant treatment.** Before a permit is granted, the owner or agent shall file with the building code official a certificate executed by an approved testing laboratory, certifying that the tents, canopies and membrane structures and their appurtenances, sidewalls, drops and tarpaulins, floor coverings, bunting, combustible decorative materials and effects, including sawdust when used on floors or passageways, shall be composed of flame-resistant material or shall be treated with a flame retardant in an approved manner and meet the requirements for flame resistance as determined in accordance with NFPA 701, and that such flame resistance is effective for the period specified by the permit.
- 22.4.3 Label.** Membrane structures, tents or canopies shall have a permanently affixed label bearing the identification of size and fabric or material type.
- 22.4.4 Certification.** An affidavit or affirmation shall be submitted to the building code official and a copy retained on the premises on which the tent or air-supported structure is located. The affidavit shall attest to the following information relative to the flame resistance of the fabric:
- 1.** Names and address of the owners of the tent, canopy or air-supported structure.
  - 2.** Date the fabric was last treated with flame-resistant solution.
  - 3.** Trade name or kind of chemical used in treatment.
  - 4.** Name of person or firm treating the material.
  - 5.** Name of testing agency and test standard by which the fabric was tested.
- 22.4.5 Combustible materials.** Hay, straw, shavings or similar combustible materials shall not be located within any tent, canopy or membrane structure containing an assembly occupancy, except the materials necessary for the daily feeding and care of animals. Sawdust and shavings utilized for a public performance or exhibit shall not be prohibited provided the sawdust and shavings are kept damp. Combustible materials shall not be permitted under stands or seats at any time. The areas within and adjacent to the tent or air-supported structure shall be maintained clear of all combustible materials or vegetation that could create a fire hazard within 6.1 m from the structure. Combustible trash shall be removed at least once a day from the structure during the period the structure is occupied by the public.

- 22.4.6 Smoking.** Smoking shall not be permitted in tents, canopies or membrane structures. Approved “No Smoking” signs shall be conspicuously posted in accordance with Section 5A.10.
- 22.4.7 Open or exposed flame.** Open flame or other devices emitting flame, fire or heat or any flammable or combustible liquids, gas, charcoal or other cooking device or any other unapproved devices shall not be permitted inside or located within 6.1 m of the tent, canopy or membrane structures while open to the public unless approved by the building code official.
- 22.4.8 Fireworks.** Fireworks shall not be used within 30.5 m of tents, canopies or membrane structures.
- 22.4.9 Spot lighting.** Spot or effect lighting shall only be by electricity, and all combustible construction located within 1.8 m of such equipment shall be protected with approved noncombustible insulation not less than 235 mm thick.
- 22.4.10 Safety film.** Motion pictures shall not be displayed in tents, canopies or membrane structures unless the motion picture film is safety film.
- 22.4.11 Clearance.** There shall be a minimum clearance of at least 0.9 m between the fabric envelope and all contents located inside the tent or membrane structure.
- 22.4.12 Portable fire extinguishers.** Portable fire extinguishers shall be provided as required by Section 7.6.
- 22.4.13 Fire protection equipment.** Fire hose lines, water supplies and other auxiliary fire equipment shall be maintained at the site in such numbers and sizes as required by the building code official.
- 22.4.14 Occupant load factors.** The occupant load allowed in an assembly structure, or portion thereof, shall be determined in accordance with Chapter 8.
- 22.4.15 Heating and cooking equipment.** Heating and cooking equipment shall be in accordance with this section.
- 22.4.15.1 Installation.** Heating or cooking equipment, tanks, piping, hoses, fittings, valves, tubing and other related components shall be installed as specified in the SBC 501 and shall be approved by the building code official.
- 22.4.15.2 Venting.** Gas, liquid and solid fuel-burning equipment designed to be vented shall be vented to the outside air as specified in the SBC 501. Such vents shall be equipped with approved spark arresters when required. Where vents or flues are used, all portions of the tent, canopy or membrane structure shall be not less than 300 mm from the flue or vent.
- 22.4.15.3 Location.** Cooking and heating equipment shall not be located within 3.0 m of exits or combustible materials.
- 22.4.15.4 Operations.** Operations such as warming of foods, cooking demonstrations and similar operations that use solid flammables, butane or other similar devices which do not pose an ignition hazard, shall be approved.
- 22.4.15.5 Cooking tents.** Tents where cooking is performed shall be separated from other tents, canopies or membrane structures by a minimum of 6.1 m.
- 22.4.15.6 Outdoor cooking.** Outdoor cooking that produces sparks or grease-laden vapors

shall not be performed within 6.1 m from a tent, canopy or membrane structure.

- 22.4.15.7 **Electrical heating and cooking equipment.** Electrical cooking and heating equipment shall comply with the SBC 401.
- 22.4.16 **LP-gas.** The storage, handling and use of LP-gas and LP-gas equipment shall be in accordance with this section.
- 22.4.16.1 **General.** LP-gas equipment such as tanks, piping, hoses, fittings, valves, tubing and other related components shall be approved and in accordance with Chapter 36.
- 22.4.16.2 **Location of containers.** LP-gas containers shall be located outside. Safety release valves shall be pointed away from the tent, canopy or membrane structure.
- 22.4.16.2.1 **Containers 500 gallons or less.** Portable LP-gas containers with a capacity of 1893 L or less shall have a minimum separation between the container and structure not less than 3.0 m.
- 22.4.16.2.2 **Containers more than 500 gallons.** Portable LP-gas containers with a capacity of more than 1,893 L shall have a minimum separation between the container and structures not less than 7.6 m.
- 22.4.16.3 **Protection and security.** Portable LP-gas containers, piping, valves and fittings which are located outside and are being used to fuel equipment inside a tent, canopy or membrane structure shall be adequately protected to prevent tampering, damage by vehicles or other hazards and shall be located in an approved location. Portable LP-gas containers shall be securely fastened in place to prevent unauthorized movement.
- 22.4.17 **Flammable and combustible liquids.** The storage of flammable and combustible liquids and the use of flammable-liquid-fueled equipment shall be in accordance with this section.
- 22.4.17.1 **Use.** Flammable-liquid-fueled equipment shall not be used in tents, canopies or membrane structures.
- 22.4.17.2 **Flammable and combustible liquid storage.** Flammable and combustible liquids shall be stored outside in an approved manner not less than 15.2 m from tents, canopies or membrane structures. Storage shall be in accordance with Chapter 32.
- 22.4.17.3 **Refueling.** Refueling shall be performed in an approved location not less than 6.1 m from tents, canopies or membrane structures.
- 22.4.18 **Display of motor vehicles.** Liquid and gas-fueled vehicles and equipment used for display within tents, canopies or membrane structures shall be in accordance with this section.
- 22.4.18.1 **Batteries.** Batteries shall be disconnected in an appropriate manner.
- 22.4.18.2 **Fuel systems.** Vehicles or equipment shall not be fueled or defueled within the tent, canopy or membrane structure.
- 22.4.18.2.1 **Quantity limit.** Fuel in the fuel tank shall not exceed one-quarter of the tank capacity or 19 L, whichever is less.
- 22.4.18.2.2 **Inspection.** Fuel systems shall be inspected for leaks.
- 22.4.18.2.3 **Closure.** Fuel tank openings shall be locked and sealed to prevent the escape of vapors.
- 22.4.18.3 **Location.** The location of vehicles or equipment shall not obstruct means of egress.
- 22.4.18.4 **Places of assembly.** When a compressed natural gas (CNG) or liquefied petroleum gas (LP-gas) powered vehicle is parked inside a place of assembly, all the following conditions shall be met:
  - 1. The quarter-turn shutoff valve or other shutoff valve on the outlet of the CNG



or LP-gas container shall be closed and the engine shall be operated until it stops. Valves shall remain closed while the vehicle is indoors.

2. The hot lead of the battery shall be disconnected.
3. Dual-fuel vehicles equipped to operate on gasoline and CNG or LP-gas shall comply with this section and Sections 22.4.18.1 through 22.4.18.5.3 for gasoline-powered vehicles.

**22.4.18.5 Competitions and demonstrations.** Liquid and gas-fueled vehicles and equipment used for competition or demonstration within a tent, canopy or membrane structure shall comply with Sections 22.4.18.5.1 through 22.4.18.5.3.

**22.4.18.5.1 Fuel storage.** Fuel for vehicles or equipment shall be stored in approved containers in an approved location outside of the structure in accordance with Section 22.4.17.2.

**22.4.18.5.2 Fueling.** Refueling shall be performed outside of the structure in accordance with Section 22.4.17.3.

**22.4.18.5.3 Spills.** Fuel spills shall be cleaned up immediately.

**22.4.19 Separation of generators.** Generators and other internal combustion power sources shall be separated from tents, canopies or membrane structures by a minimum of 6.1 m and shall be isolated from contact with the public by fencing, enclosure or other approved means.

**22.4.20 Standby personnel.** When, in the opinion of the building code official, it is essential for public safety in a tent, canopy or membrane structure used as a place of assembly or any other use where people congregate, because of the number of persons, or the nature of the performance, exhibition, display, contest or activity, the owner, agent or lessee shall employ one or more qualified persons, as required and approved, to remain on duty during the times such places are open to the public, or when such activity is being conducted.

Before each performance or the start of such activity, standby personnel shall keep diligent watch for fires during the time such place is open to the public or such activity is being conducted and take prompt measures for extinguishment of fires that occur and assist in the evacuation of the public from the structure.

There shall be trained crowd managers or crowd manager supervisors at a ratio of one crowd manager/supervisor for every 250 occupants, as approved.

**22.4.21 Vegetation removal.** Combustible vegetation shall be removed from the area occupied by a tent, canopy or membrane structure, and from areas within 9.1 m of such structures.

**22.4.22 Waste material.** The floor surface inside tents, canopies or membrane structures and the grounds outside and within a 9.1 m perimeter shall be kept clear of combustible waste. Such waste shall be stored in approved containers until removed from the premises.

## CHAPTER 23 TIRE REBUILDING AND TIRE STORAGE

### SECTION 23.1 GENERAL

- 23.1.1 Scope.** Tire rebuilding plants, tire storage and tire by-product facilities shall comply with this chapter, other applicable requirements of this code and NFPA 231D. Tire storage in buildings shall also comply with Chapter 21.
- 23.1.2 Permit required.** Permits shall be required as set forth in SBC 100.

### SECTION 23.2 DEFINITIONS

- 23.2.1 Terms defined in Chapter 1.** Words and terms used in this chapter and defined in Chapter 1 shall have the meanings ascribed to them as defined therein.

### SECTION 23.3 TIRE REBUILDING

- 23.3.1 Construction.** Tire rebuilding plants shall comply with the regulations and requirements of the SBC, as to construction, separation from other buildings or other portions of the same building, and protection.
- 23.3.2 Location.** Buffing operations shall be located in a room separated from the remainder of the building housing the tire rebuilding or tire recapping operations by a 1-hour fire barrier.
- Exception:** Buffing operations are not required to be separated where all of the following conditions are met:
1. Buffing operations are equipped with an approved continuous automatic water-spray system directed at the point of cutting action;
  2. Buffing machines are connected to particle-collecting systems providing a minimum air movement of 0.71 m<sup>3</sup>/s in volume and 23 m/s in-line velocity; and
  3. The collecting system shall discharge the rubber particles to an approved outdoor noncombustible or fire-resistant container, which is emptied at frequent intervals to prevent overflow.
- 23.3.3 Cleaning.** The buffing area shall be cleaned at frequent intervals to prevent the accumulation of rubber particles.
- 23.3.4 Spray rooms and booths.** Each spray room or spray booth where flammable or combustible solvents are applied, shall comply with Chapter 12.

### SECTION 23.4 PRECAUTIONS AGAINST FIRE

- 23.4.1 Open burning.** Open burning is prohibited in tire storage yards.
- 23.4.2 Sources of heat.** Cutting, welding or heating devices shall not be operated in tire storage yards.

- 23.4.3 Smoking prohibited.** Smoking is prohibited in tire storage yards, except in designated areas.
- 23.4.4 Power lines.** Tire storage piles shall not be located beneath electrical power lines having a voltage in excess of 750 volts or that supply power to fire emergency systems.
- 23.4.5 Fire safety plan.** The owner or individual in charge of the tire storage yard shall be required to prepare and submit to the building code official a fire safety plan for review and approval. The fire safety plan shall include provisions for Civil Defence vehicle access. At least one copy of the fire safety plan shall be prominently posted and maintained at the storage yard.
- 23.4.6 Telephone number.** The telephone number of the Civil Defence and location of the nearest telephone shall be posted conspicuously in attended locations.

## SECTION 23.5 OUTDOOR STORAGE

- 23.5.1 Individual piles.** Tire storage shall be restricted to individual piles not exceeding 465 m<sup>2</sup> of continuous area. Piles shall not exceed 1,416 m<sup>3</sup> in volume or 3.0 m in height.
- 23.5.2 Separation of piles.** Individual tire storage piles shall be separated from other piles of salvage by a clear space of at least 12.2 m.
- 23.5.3 Distance between piles of other stored products.** Tire storage piles shall be separated by a clear space of at least 12.2 m from piles of other stored product.
- 23.5.4 Distance from lot lines and buildings.** Tire storage piles shall be located at least 15.2 m from lot lines and buildings.
- 23.5.5 Fire breaks.** Storage yards shall be maintained free from combustible ground vegetation for a distance of 12.2 m from the stored material to grass and weeds; and for a distance of 30.5 m from the stored product to brush and forested areas.
- 23.5.6 Volume more than 4,248 m<sup>3</sup>.** Where the bulk volume of stored product is more than 4,248 m<sup>3</sup>, storage arrangement shall be in accordance with the following:
1. Individual storage piles shall comply with size and separation requirements in Sections 23.5.1 through 23.5.6.
  2. Adjacent storage piles shall be considered a group, and the aggregate volume of storage piles in a group shall not exceed 4,248 m<sup>3</sup>. Separation between groups shall be at least 23.0 m wide.
- 23.5.7 Location of storage.** Outdoor waste tire storage shall not be located under bridges, elevated trestles, elevated road-ways or elevated railroads.

## SECTION 23.6 CIVIL DEFENCE ACCESS

- 23.6.1 Required access.** New and existing tire storage yards shall be provided with fire apparatus access roads in accordance with Section 5A.3 and this section.

- 23.6.2 Location.** Fire apparatus access roads shall be located within all pile clearances identified in Sections 23.5.4 and within all fire breaks required in Section 23.5.5. Access roadways shall be within 45.7 m of any point in the storage yard where storage piles are located, at least 6.1 m from any storage pile.

### SECTION 23.7 FENCING

- 23.7.1 Where required.** Where the bulk volume of stored material is more than 566 m<sup>3</sup>, a firmly anchored fence or other approved method of security that controls unauthorized access to the storage yard shall surround the storage yard.
- 23.7.2 Construction.** The fence shall be constructed of approved materials and shall be at least 1.8 m high and provided with gates at least 6.1 m wide.
- 23.7.3 Locking.** All gates to the storage yard shall be locked when the storage yard is not staffed.
- 23.7.4 Unobstructed.** Gateways shall be kept clear of obstructions and be fully openable at all times.

### SECTION 23.8 FIRE PROTECTION

- 23.8.1 Water supply.** A public or private fire protection water supply shall be provided in accordance with Section 5A.8. The water supply shall be arranged such that any part of the storage yard can be reached by using not more than 152.4 m of hose.
- 23.8.2 Fire extinguishers.** Buildings or structures shall be provided with portable fire extinguishers in accordance with Section 7.6. Fuel-fired vehicles operating in the storage yard shall be equipped with a minimum 2-A:20-B:C rated portable extinguisher.

### SECTION 23.9 INDOOR STORAGE ARRANGEMENT

- 23.9.1 Pile dimensions.** Where tires are stored on-tread, the dimension of the pile in the direction of the wheel hole shall not be more than 15.2 m. Tires stored adjacent to or along one wall shall not extend more than 7.6 m from that wall. Other piles shall not be more than 15.2 m in width.

## CHAPTER 24 WELDING AND OTHER HOT WORK

### SECTION 24.1 GENERAL

- 24.1.1 Scope.** Welding, cutting, open torches and other hot work operations and equipment shall comply with this chapter.
- 24.1.2 Permits.** Permits shall be required as set forth in SBC 100.
- 24.1.3 Restricted areas.** Hot work shall only be conducted in areas designed or authorized for that purpose by the personnel responsible for a Hot Work Program. Hot work shall not be conducted in the following areas unless approval has been obtained from the building code official:
1. Areas where the sprinkler system is impaired.
  2. Areas where there exists the potential of an explosive atmosphere, such as locations where flammable gases, liquids or vapors are present.
  3. Areas with readily ignitable materials, such as storage of large quantities of bulk sulfur, baled paper, cotton, lint, dust or loose combustible materials.
  4. On board ships at dock or ships under construction or repair.
  5. At other locations as specified by the building code official.
- 24.1.4 Cylinders and containers.** Compressed gas cylinders and fuel containers shall comply with this chapter and Chapter 28.
- 24.1.5 Design and installation of oxygen-fuel gas systems.** An oxygen-fuel gas system with two or more manifolded cylinders of oxygen shall be in accordance with NFPA 51.

### SECTION 24.2 DEFINITIONS

- 24.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**HOT WORK.** Operations including cutting, welding, thermit welding, brazing, soldering, grinding, thermal spraying, thawing pipe, installation of torch-applied roof systems or any other similar activity.

**HOT WORK AREA.** The area exposed to sparks, hot slag, radiant heat, or convective heat as a result of the hot work.

**HOT WORK EQUIPMENT.** Electric or gas welding or cutting equipment use for hot work.

**HOT WORK PERMITS.** Permits issued by the responsible person at the facility under the hot work permit program permitting welding or other hot work to be done in locations referred to in Section 24.3.3 and pre-permitted by the building code official.

**HOT WORK PROGRAM.** A permitted program, carried out by approved facilities-designated personnel, allowing them to oversee and issue permits for hot work conducted by their personnel or at their facility. The intent is to have trained, on-site, responsible personnel ensure that required hot work safety measures are taken to prevent fires and fire spread.

**RESPONSIBLE PERSON.** A person trained in the safety and fire safety considerations concerned with hot work. Responsible for reviewing the sites prior to issuing permits as part of the hot work permit program and following up as the job progresses.

**TORCH-APPLIED ROOF SYSTEM.** Bituminous roofing systems using membranes that are adhered by heating with a torch and melting asphalt back coating instead of mopping hot asphalt for adhesion.

### SECTION 24.3 GENERAL REQUIREMENTS

- 24.3.1      General.** Hot work conditions and operations shall comply with this chapter.
- 24.3.2      Temporary and fixed hot work areas.** Temporary and fixed hot work areas shall comply with this section.
- 24.3.3      Hot work program permit.** Hot work permits, issued by an approved responsible person under a hot work program, shall be available for review by the building code official at the time the work is conducted and for 48 hours after work is complete.
- 24.3.4      Qualifications of operators.** A permit for hot work operations shall not be issued unless the individuals in charge of performing such operations are capable of performing such operations safely. Demonstration of a working knowledge of the provisions of this chapter shall constitute acceptable evidence of compliance with this requirement.
- 24.3.5      Records.** The individual responsible for the hot work area shall maintain “prework check” reports in accordance with Section 24.4.3.1. These reports shall be maintained on the premises for a minimum of 48 hours after work is complete.
- 24.3.6      Signage.** Visible hazard identification signs shall be provided where required by Chapter 25. Where the hot work area is accessible to persons other than the operator of the hot work equipment, conspicuous signs shall be posted to warn others before they enter the hot work area. Such signs shall display the following warning:

CAUTION  
HOT WORK IN PROGRESS STAY CLEAR.

### SECTION 24.4 FIRE SAFETY REQUIREMENTS

- 24.4.1      Protection of combustibles.** Protection of combustibles shall be in accordance with Sections 24.4.1.1 through 24.4.1.9.
- 24.4.1.1      Combustibles.** Hot work areas shall not contain combustibles or shall be provided

with appropriate shielding to prevent sparks, slag or heat from igniting exposed combustibles.

- 24.4.1.2 **Openings.** Openings or cracks in walls, floors, ducts or shafts within the hot work area shall be tightly covered to prevent the passage of sparks to adjacent combustible areas, or shielded by metal fire-resistant guards, or curtains shall be provided to prevent passage of sparks or slag.
- 24.4.1.3 **Housekeeping.** Floors shall be kept clean within the hot work area.
- 24.4.1.4 **Conveyor systems.** Conveyor systems that are capable of carrying sparks to distant combustibles shall be shielded or shut down.
- 24.4.1.5 **Partitions.** Partitions segregating hot work areas from other areas of the building shall be noncombustible. In fixed hot work areas, the partitions shall be securely connected to the floor such that no gap exists between the floor and the partition. Partitions shall prevent the passage of sparks, slag, and heat from the hot work area.
- 24.4.1.6 **Floors.** Fixed hot work areas shall have floors with noncombustible surfaces.
- 24.4.1.7 **Precautions in hot work.** Hot work shall not be performed on containers or equipment that contains or has contained flammable liquids, gases or solids until the containers and equipment have been thoroughly cleaned, inerted or purged; except that "hot tapping" shall be allowed on tanks and pipe lines when such work is to be conducted by approved personnel.
- 24.4.1.8 **Sprinkler protection.** Automatic sprinkler protection shall not be shutoff while hot work is performed. Where hot work is performed close to automatic sprinklers, noncombustible barriers or damp cloth guards shall shield the individual sprinkler heads and shall be removed when the work is completed. If the work extends over several days, the shields shall be removed at the end of each work-day. The building code official shall approve hot work where sprinkler protection is impaired.
- 24.4.1.9 **Fire detection systems.** Approved special precautions shall be taken to avoid accidental operation of automatic fire detection systems.
- 24.4.2 **Fire watch.** Fire watches shall be established and conducted in accordance with Sections 24.4.2.1 through 24.4.2.6.
- 24.4.2.1 **When required.** A fire watch shall be provided during hot work activities and shall continue for a minimum of 30 minutes after the conclusion of the work. The building code official, or the responsible manager under a hot work program, is authorized to extend the fire watch based on the hazards or work being performed.  
**Exception:** Where the hot work area has no fire hazards or combustible exposures.
- 24.4.2.2 **Location.** The fire watch shall include the entire hot work area. Hot work conducted in areas with vertical or horizontal fire exposures that are not observable by a single individual shall have additional personnel assigned to fire watches to ensure that exposed areas are monitored.
- 24.4.2.3 **Duties.** Individuals designated to fire watch duty shall have fire-extinguishing equipment readily available and shall be trained in the use of such equipment. Individuals assigned to fire watch duty shall be responsible for extinguishing spot fires and communicating an alarm.
- 24.4.2.4 **Fire training.** The individuals responsible for performing the hot work and individuals responsible for providing the fire watch shall be trained in the use of portable fire extinguishers.
- 24.4.2.5 **Fire hoses.** Where hoselines are required, they shall be connected, charged and ready for operation.
- 24.4.2.6 **Fire extinguisher.** A minimum of one portable fire extinguisher complying with Section 7.6 and with a minimum 2-A:20-B:C rating shall be readily accessible

within 9.1 m of the location where hot work is performed.

- 24.4.3 Area reviews.** Before hot work is permitted and at least once per day while the permit is in effect, the area shall be inspected by the individual responsible for authorizing hot work operations to ensure that it is a fire safe area. Information shown on the permit shall be verified prior to signing the permit in accordance with SBC 100.
- 24.4.3.1 Pre-hot-work check.** A pre-hot-work check shall be conducted prior to work to ensure that all equipment is safe and hazards are recognized and protected. A report of the check shall be kept at the work site during the work and available upon request. The pre-hot-work check shall determine all of the following:
1. Hot work equipment to be used shall be in satisfactory operating condition and in good repair.
  2. Hot work site is clear of combustibles or combustibles are protected.
  3. Exposed construction is of noncombustible materials or, if combustible, then protected.
  4. Openings are protected.
  5. Floors are kept clean.
  6. No exposed combustibles are located on the opposite side of partitions, walls, ceilings or floors.
  7. Fire watches, where required, are assigned.
  8. Approved actions have been taken to prevent accidental activation of suppression and detection equipment in accordance with Sections 24.4.1.8 and 24.4.1.9.
  9. Fire extinguishers and fire hoses (where provided) are operable and available.

## SECTION 24.5 GAS WELDING AND CUTTING

- 24.5.1 General.** Devices or attachments mixing air or oxygen with combustible gases prior to consumption, except at the burner or in a standard torch or blow pipe, shall not be allowed unless approved.
- 24.5.2 Cylinder and container storage, handling and use.** Storage, handling and use of compressed gas cylinders, containers and tanks shall be in accordance with this section and Chapter 28.
- 24.5.3 Precautions.** Cylinders, valves, regulators, hose and other apparatus and fittings for oxygen shall be kept free from oil or grease. Oxygen cylinders, apparatus and fittings shall not be handled with oily hands, oily gloves, or greasy tools or equipment.
- 24.5.4 Acetylene gas.** Acetylene gas shall not be piped except in approved cylinder manifolds and cylinder manifold connections, or utilized at a pressure exceeding 103 kPa unless dissolved in a suitable solvent in cylinders manufactured in accordance with MOT Standards. Acetylene gas shall not be brought in contact with unalloyed copper, except in a blowpipe or torch.
- 24.5.5 Remote locations.** Oxygen and fuel-gas cylinders and acetylene generators shall be located away from the hot work area to prevent such cylinders or generators from being heated by radiation from heated materials, sparks or slag, or misdirection of the torch flame.



- 24.5.6 Cylinders shutoff.** The torch valve shall be closed and the gas supply to the torch completely shutoff when gas welding or cutting operations are discontinued for a period of 1 hour or more.
- 24.5.7 Prohibited operation.** Welding or cutting work shall not be held or supported on compressed gas cylinders or containers.
- 24.5.8 Tests.** Tests for leaks in piping systems and equipment shall be made with soapy water. The use of flames shall be prohibited for leak testing.

## SECTION 24.6 ELECTRIC ARC HOT WORK

- 24.6.1 General.** The frame or case of electric hot work machines, except internal-combustion-engine-driven machines, shall be grounded. Ground connections shall be mechanically strong and electrically adequate for the required current.
- 24.6.2 Return circuits.** Welding current return circuits from the work to the machine shall have proper electrical contact at joints. The electrical contact shall be periodically inspected.
- 24.6.3 Disconnecting.** Electrodes shall be removed from the holders when electric arc welding or cutting is discontinued for any period of 1 hour or more. The holders shall be located to prevent accidental contact and the machines shall be disconnected from the power source.
- 24.6.4 Emergency disconnect.** A switch or circuit breaker shall be provided so that fixed electric welders and control equipment can be disconnected from the supply circuit. The disconnect shall be installed in accordance with the SBC 401.
- 24.6.5 Damaged cable.** Damaged cable shall be removed from service until properly repaired or replaced.

## SECTION 24.7 CALCIUM CARBIDE SYSTEMS

- 24.7.1 Calcium carbide storage.** Storage and handling of calcium carbide shall comply with Chapter 25 of these code requirements and Chapter 7 of NFPA 51.

## SECTION 24.8 ACETYLENE GENERATORS

- 24.8.1 Use of acetylene generators.** The use of acetylene generators shall comply with this section and Chapter 4 of NFPA 51A.
- 24.8.2 Portable generators.** The minimum volume of rooms containing portable generators shall be 35 times the total gas-generating capacity per charge of all generators in the room. The gas-generating capacity in cubic meter per charge shall be assumed to be 4.5 times the weight of carbide per charge in kilogram. The minimum ceiling height of rooms containing generators shall be 3.0 m. An acetylene generator shall not be moved by derrick, crane or hoist while charged.

- 24.8.3 Protection against freezing.** Generators shall be located where water will not freeze. Common salt such as sodium chloride or other corrosive chemicals shall not be utilized for protection against freezing.

**SECTION 24.9  
PIPING MANIFOLDS AND HOSE SYSTEMS FOR FUEL GASES  
AND OXYGEN**

- 24.9.1 General.** The use of piping manifolds and hose systems shall be in accordance with Section 24.9, Chapter 28 and Chapter 3 of NFPA 51.
- 24.9.2 Protection.** Piping shall be protected against physical damage.
- 24.9.3 Signage.** Signage shall be provided for piping and hose systems as follows:
- 1.** Above-ground piping systems shall be marked in accordance with ANSI A13.1.
  - 2.** Station outlets shall be marked to indicate their intended usage.
  - 3.** Signs shall be posted, indicating clearly the location and identity of section shutoff valves.
- 24.9.4 Manifolding of cylinders.** Oxygen manifolds shall not be located in an acetylene generator room. Oxygen manifolds shall be located at least 6.1 m away from combustible material such as oil or grease, and gas cylinders containing flammable gases, unless the gas cylinders are separated by a fire partition.
- 24.9.5 Identification of manifolds.** Signs shall be posted for oxygen manifolds with service pressures not exceeding 1,379 kPa. Such signs shall include the words:

LOW-PRESSURE MANIFOLD  
DO NOT CONNECT HIGH-PRESSURE CYLINDERS  
MAXIMUM PRESSURE 1723.8 kPa

- 24.9.6 Clamps.** Hose connections shall be clamped or otherwise securely fastened.
- 24.9.7 Inspection.** Hoses shall be inspected frequently for leaks, burns, wear, loose connections or other defects rendering the hose unfit for service.

## CHAPTER 25 HAZARDOUS MATERIALS—GENERAL PROVISIONS

### SECTION 25.1 GENERAL

**25.1.1 Scope.** Prevention, control and mitigation of dangerous conditions related to storage, dispensing, use and handling of hazardous materials shall be in accordance with this chapter. This chapter shall apply to all hazardous materials, including those materials regulated elsewhere in the code requirements, except that when specific requirements are provided in other chapters, those specific requirements shall apply in accordance with the applicable chapter. Where a material has multiple hazards, all hazards shall be addressed.

**Exceptions:**

1. The quantities of, medicines, foodstuffs, cosmetics, and consumer or industrial products containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, in retail or wholesale sales occupancies, are unlimited when packaged in individual containers not exceeding 5 L.
2. Application and release of pesticide and agricultural products and materials intended for use in weed abatement, erosion control, soil amendment or similar applications when applied in accordance with the manufacturer's instructions and label directions.
3. The off-site transportation of hazardous materials when in accordance with MOI regulations.
4. Building materials not otherwise regulated by the code requirements.
5. Refrigeration systems (see Section 5D.6).
6. Stationary lead-acid batteries regulated by Section 5D.8.
7. The display, storage, sale or use of fireworks and explosives in accordance with Chapter 31.
8. Corrosives utilized in personal and household products in the manufacturer's original consumer packaging in Group M occupancies.

**25.1.1.1 Waiver.** The provisions of this chapter are waived when the building code official determines that such enforcement is preempted by other codes, statutes or ordinances. The details of any action granting such a waiver shall be recorded and entered in the files of the code enforcement agency.

**25.1.2 Material classification.** Hazardous materials are those chemicals or substances defined as such in the code requirements. Definitions of hazardous materials shall apply to all hazardous materials, including those materials regulated elsewhere in SBC 201.

**25.1.2.1 Mixtures.** Mixtures shall be classified in accordance with hazards of the mixture as a whole. Mixtures of hazardous materials shall be classified in accordance with nationally recognized reference standards; by an approved qualified organization, individual, or Material Safety Data Sheet (MSDS); or by other approved methods.

**25.1.2.2 Hazard categories.** Hazardous materials shall be classified according to hazard categories. The categories include materials regulated by this chapter and materials regulated elsewhere in the SBC 201.

**25.1.2.2.1 Physical hazards.** The material categories listed in this section are classified as physical hazards. A material with a primary classification as a physical hazard can also pose a health hazard.

1. Explosives and blasting agents.
2. Flammable and combustible liquids.
3. Flammable solids and gases.
4. Organic peroxide materials.
5. Oxidizer materials.
6. Pyrophoric materials.
7. Unstable (reactive) materials.
8. Water-reactive solids and liquids.
9. Cryogenic fluids.

**25.1.2.2.2 Health hazards.** The material categories listed in this section are classified as health hazards. A material with a primary classification as a health hazard can also pose a physical hazard.

1. Highly toxic and toxic materials.
2. Corrosive materials.

**25.1.3 Performance-based design alternative.** When approved by the building code official, buildings and facilities where hazardous materials are stored, used or handled shall be permitted to comply with this section as an alternative to compliance with the other requirements set forth in this chapter and Chapters 26 through 45.

**25.1.3.1 Objective.** The objective of Section 25.1.3 is to protect people and property from the consequences of unauthorized discharge, fires or explosions involving hazardous materials.

**25.1.3.2 Functional statements.** Performance-based design alternatives are based on the following functional statements:

1. Provide safeguards to minimize the risk of unwanted releases, fires or explosions involving hazardous materials.
2. Provide safeguards to minimize the consequences of an unsafe condition involving hazardous materials during normal operations and in the event of an abnormal condition.

**25.1.3.3 Performance requirements.** When safeguards, systems, documentation, written plans or procedures, audits, process hazards analysis, mitigation measures, engineering controls or construction features are required by Sections 25.1.3.3.1 through 25.1.3.3.18, the details of the design alternative shall be subject to approval by the code official. The details of actions granting the use of the design alternatives shall be recorded and entered in the files in accordance with the SBC 100.

**25.1.3.3.1 Properties of hazardous materials.** The physical and health-hazard properties of hazardous materials on site shall be known and shall be made readily available to employees, neighbors and the building code official.

**25.1.3.3.2 Reliability of equipment and operations.** Equipment and operations involving hazardous materials shall be designed, installed and maintained to ensure that they reliably operate as intended.

**25.1.3.3.3 Prevention of unintentional reaction or release.** Safeguards shall be provided to minimize the risk of an unintentional reaction or release that could endanger people or property.

**25.1.3.3.4 Spill mitigation.** Spill containment systems or means to render a spill harmless to people or property shall be provided where a spill is determined to be a plausible event and where such an event would endanger people or property.

**25.1.3.3.5 Ignition hazards.** Safeguards shall be provided to minimize the risk of exposing combustible hazardous materials to unintended sources of ignition.

- 25.1.3.3.6 Protection of hazardous materials.** Safeguards shall be provided to minimize the risk of exposing hazardous materials to a fire or physical damage whereby such exposure could endanger or lead to the endangerment of people or property.
- 25.1.3.3.7 Exposure hazards.** Safeguards shall be provided to minimize the risk of and limit damage from a fire or explosion involving explosive hazardous materials whereby such fire or explosion could endanger or lead to the endangerment of people or property.
- 25.1.3.3.8 Detection of gas or vapor release.** Where a release of hazardous materials gas or vapor would cause immediate harm to persons or property, means of detecting, diluting or otherwise mitigating the dangerous effects of a release shall be provided.
- 25.1.3.3.9 Reliable power source.** Where a power supply is relied upon to prevent or control an emergency condition that could endanger people or property, the power supply shall be from a reliable source.
- 25.1.3.3.10 Ventilation.** Where ventilation is necessary to limit the risk of creating an emergency condition resulting from normal or abnormal operations, means of ventilation shall be provided.
- 25.1.3.3.11 Process hazard analyses.** Process hazard analyses shall be conducted to ensure reasonably the protection of people and property from dangerous conditions involving hazardous materials.
- 25.1.3.3.12 Pre-startup safety review.** Written documentation of pre-startup safety review procedures shall be developed and enforced to ensure that operations are initiated in a safe manner. The process of developing and updating such procedures shall involve participation of affected employees.
- 25.1.3.3.13 Operating and emergency procedures.** Written documentation of operating procedures and procedures for emergency shut down shall be developed and enforced to ensure that operations are conducted in a safe manner. The process of developing and updating such procedures shall involve participation of affected employees.
- 25.1.3.3.14 Management of change.** A written plan for management of change shall be developed and enforced. The process of developing and updating the plan shall involve participation of affected employees.
- 25.1.3.3.15 Emergency response plan.** A written emergency response plan shall be developed to ensure that proper actions are taken in the event of an emergency, and the plan shall be followed if an emergency condition occurs. The process of developing and updating the plan shall involve participation of affected employees.
- 25.1.3.3.16 Accident procedures.** Written procedures for investigation and documentation of accidents shall be developed, and accidents shall be investigated and documented in accordance with these procedures.
- 25.1.3.3.17 Consequence analysis.** Where an accidental release of hazardous materials could endanger people or property, either on or off-site, an analysis of the expected consequences of a plausible release shall be performed and utilized in the analysis and selection of active and passive hazard mitigation controls.
- 25.1.3.3.18 Safety audits.** Safety audits shall be conducted on a periodic basis to verify compliance with the requirements of this section.
- 25.1.4 Retail and wholesale storage and display.** For retail and wholesale storage and display of nonflammable solid and nonflammable or noncombustible liquid hazardous materials in Group M occupancies and storage in Group S occupancies, see Section 25.3.11.

- 25.1.5 Permits.** Permits shall be required as set forth in SBC 100. When required by the building code official, permittees shall apply for approval to permanently close a storage, use or handling facility. Such application shall be submitted in accordance with SBC 100 prior to the termination of the storage, use or handling of hazardous materials. The building code official is authorized to require that the application be accompanied by an approved facility closure plan in accordance with Section 25.1.5.3.
- 25.1.5.1 Hazardous Materials Management Plan.** Where required by the building code official, each application for a permit shall include a Hazardous Materials Management Plan (HMMP). The HMMP shall include a facility site plan designating the following:
1. Storage and use areas.
  2. Maximum amount of each material stored or used in each area.
  3. Range of container sizes.
  4. Locations of emergency isolation and mitigation valves and devices.
  5. Product conveying piping containing liquids or gases, other than utility-owned fuel gas lines and low-pressure fuel gas lines.
  6. On and off positions of valves for valves that are of the self-indicating type.
  7. Storage plan showing the intended storage arrangement, including the location and dimensions of aisles.
  8. The location and type of emergency equipment. The plans shall be legible and drawn approximately to scale. Separate distribution systems are allowed to be shown on separate pages.
- 25.1.5.2 Hazardous Materials Inventory Statement (HMIS).** Where required by the building code official, an application for a permit shall include an HMIS, such as SARA (Superfund Amendments and Reauthorization Act of 1986) Title III, Tier II Report, or other approved statement. The HMIS shall include the following information:
1. Manufacturer's name.
  2. Chemical name, trade names, hazardous ingredients.
  3. Hazard classification.
  4. MSDS or equivalent.
  5. United Nations (UN), North America (NA) or the Chemical Abstract Service (CAS) identification number.
  6. Maximum quantity stored or used on-site at one time.
  7. Storage conditions related to the storage type, temperature and pressure.
- 25.1.6 Facility closure.** Facilities shall be placed out of service in accordance with Sections 25.1.6.1 through 25.1.6.3.
- 25.1.6.1 Temporarily out-of-service facilities.** Facilities that are temporarily out of service shall continue to maintain a permit and be monitored and inspected.
- 25.1.6.2 Permanently out-of-service facilities.** Facilities for which a permit is not kept current or is not monitored and inspected on a regular basis shall be deemed to be permanently out of service and shall be closed in an approved manner. When required by the building code official, permittees shall apply for approval to close permanently storage, use or handling facilities. The building code official is authorized to require that such application be accompanied by an approved facility closure plan in accordance with Section 25.1.5.3.
- 25.1.6.3 Facility closure plan.** When a facility closure plan is required in accordance with Section 25.1.4 to terminate storage, dispensing, handling or use of hazardous materials, it shall be submitted to the building code official in accordance with SBC 100 prior to facility closure. The plan shall demonstrate that hazardous

materials which are stored, dispensed, handled or used in the facility will be transported, disposed of or reused in a manner that eliminates the need for further maintenance and any threat to public health and safety.

## SECTION 25.2 DEFINITIONS

**25.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter, Chapters 26 through 42, and as used elsewhere in the code requirements, have the meanings shown herein.

**BOILING POINT.** The temperature at which the vapor pressure of a liquid equals the atmospheric pressure of 101 kPa or 760 mm of mercury. Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for the purposes of this classification, the 20-percent evaporated point of a distillation performed in accordance with ASTM D 86 shall be used as the boiling point of the liquid.

**CEILING LIMIT.** The maximum concentration of an air-borne contaminant to which one may be exposed. The ceiling limits utilized are those published in DOL 29 CFR Part 1910.1000. The ceiling Recommended Exposure Limit REL-C concentrations published by (the U.S. National Institute for Occupational Safety and Health (NIOSH)), Threshold Limit Value-Ceiling (TLV-C) concentrations published by (the American Conference of Governmental Industrial Hygienists (ACGIH)), ceiling Workplace Environmental Exposure Level (WEEL-Ceiling) Guides published by the American Industrial Hygiene Association (AIHA), and other approved, consistent measures are allowed as surrogates for hazardous substances not listed in DOL 29 CFR Part 1910.1000.

**CHEMICAL.** An element, chemical compound or mixture of elements or compounds or both.

**CHEMICAL NAME.** The scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry, the Chemical Abstracts Service rules of nomenclature, or a name which will clearly identify a chemical for the purpose of conducting an evaluation.

**CLOSED CONTAINER.** A container sealed by means of a lid or other device such that liquid, vapor or dusts will not escape from it under ordinary conditions of use or handling.

**CONTAINER.** A vessel of 227 L or less in capacity used for transporting or storing hazardous materials. Pipes, piping systems, engines and engine fuel tanks are not considered to be containers.

**CONTROL AREA.** Spaces within a building which are enclosed and bounded by exterior walls, fire walls, fire barriers and roofs, or a combination thereof, where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled.

**CYLINDER.** A pressure vessel designed for pressures higher than 275.6 kPa and having a circular cross section. It does not include a portable tank, multi-unit tank car tank, cargo tank or tank car.

**DEFLAGRATION.** An exothermic reaction, such as the extremely rapid oxidation of a flammable dust or vapor in air, in which the reaction progresses through the unburned material at a rate less than the velocity of sound. A deflagration can have an explosive effect.

**DESIGN PRESSURE.** The maximum gauge pressure that a pressure vessel, device, component or system is designed to withstand safely under the temperature and conditions of use expected.

**DETACHED BUILDING.** A separate single-story building, without a basement or crawl space, used for the storage or use of hazardous materials and located an approved distance from all structures.

**DISPENSING.** The pouring or transferring of any material from a container, tank or similar vessel, whereby vapors, dusts, fumes, mists or gases are liberated to the atmosphere.

**EXCESS FLOW CONTROL.** A fail-safe system or other approved means designed to shutoff flow caused by a rupture in pressurized piping systems.

**EXHAUSTED ENCLOSURE.** An appliance or piece of equipment which consists of a top, a back and two sides providing a means of local exhaust for capturing gases, fumes, vapors and mists. Such enclosures include laboratory hoods, exhaust fume hoods and similar appliances and equipment used to retain and exhaust locally the gases, fumes, vapors and mists that could be released. Rooms or areas provided with general ventilation, in themselves, are not exhausted enclosures.

**EXPLOSION.** An effect produced by the sudden violent expansion of gases, which may be accompanied by a shock wave or disruption, or both, of enclosing materials or structures. An explosion could result from any of the following:

1. Chemical changes such as rapid oxidation, deflagration or detonation, decomposition of molecules and runaway polymerization (usually detonations).
2. Physical changes such as pressure tank ruptures.
3. Atomic changes (nuclear fission or fusion).

**FLAMMABLE VAPORS OR FUMES.** The concentration of flammable constituents in air that exceeds 25 percent of their lower flammable limit (LFL).

**GAS CABINET.** A fully enclosed, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage or use. Doors and access ports for exchanging cylinders and accessing pressure-regulating controls are allowed to be included.

**GAS ROOM.** A separately ventilated, fully enclosed room in which only compressed gases and associated equipment and supplies are stored or used.



**HANDLING.** The deliberate transport by any means to a point of storage or use.

**HAZARDOUS MATERIALS.** Those chemicals or substances which are physical hazards or health hazards as defined and classified in this chapter, whether the materials are in usable or waste condition.

**HEALTH HAZARD.** A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term “health hazard” includes chemicals that are toxic, highly toxic and corrosive.

**IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH).** The concentration of air-borne contaminants which poses a threat of death, immediate or delayed permanent adverse health effects, or effects that could prevent escape from such an environment. This contaminant concentration level is established by National Institute of Occupational Safety and Health (NIOSH) based on both toxicity and flammability. It generally is expressed in milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ). If adequate data do not exist for precise establishment of IDLH concentrations, an independent certified industrial hygienist, industrial toxicologist, appropriate regulatory agency or other source approved by the building code official shall make such determination.

**INCOMPATIBLE MATERIALS.** Materials that, when mixed, have the potential to react in a manner which generates heat, fumes, gases or by-products which are hazardous to life or property.

**LIQUID.** A material having a melting point that is equal to or less than  $20^{\circ}\text{C}$  and a boiling point which is greater than  $20^{\circ}\text{C}$  at 101 kPa. When not otherwise identified, the term “liquid” includes both flammable and combustible liquids.

**LOWER EXPLOSIVE LIMIT (LEL).** See “Lower flammable limit.”

**LOWER FLAMMABLE LIMIT (LFL).** The minimum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. The LFL is sometimes referred to as LEL or lower explosive limit.

**MATERIAL SAFETY DATA SHEET (MSDS).** Information concerning a hazardous material which is prepared in accordance with the provisions of DOL 29 CFR Part 1910.1200 or in accordance with the provisions of a locally approved plan.

**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA.** The maximum amount of a hazardous material allowed to be stored or used within a control area inside a building or an outdoor control area. The maximum allowable quantity per control area is based on the material state (solid, liquid or gas) and the material storage or use conditions.

**NORMAL TEMPERATURE AND PRESSURE (NTP).** A temperature of  $21^{\circ}\text{C}$  and a pressure of 1 atmosphere [101 kPa].

**OUTDOOR CONTROL AREA.** An outdoor area that contains hazardous materials in amounts not exceeding the maximum allowable quantities of Table 25.3.1.1(3) or 25.3.1.1(4).

**PERMISSIBLE EXPOSURE LIMIT (PEL).** The maximum permitted 8 hours time-weighted-average concentration of an air-borne contaminant. The exposure limits to be utilized are those published in DOL 29 CFR Part 1910.1000. The Recommended Exposure Limit (REL) concentrations published by the U.S. National Institute for Occupational Safety and Health (NIOSH), Threshold Limit Value-Time Weighted Average (TLV-TWA) concentrations published by the American Conference of Governmental Industrial Hygienists (ACGIH), Workplace Environmental Exposure Level (WEEL) Guides published by the American Industrial Hygiene Association (AIHA), and other approved, consistent measures are allowed as surrogates for hazardous substances not listed in DOL 29 CFR Part 1910.1000.

**PESTICIDE.** A substance or mixture of substances, including fungicides, intended for preventing, destroying, repelling or mitigating pests and substances or a mixture of substances intended for use as a plant regulator, defoliant or desiccant. Products defined as drugs in the Local Food, Drug and Cosmetic Act are not pesticides.

**PHYSICAL HAZARD.** A chemical for which there is evidence that it is a combustible liquid, compressed gas, cryogenic, explosive, flammable gas, flammable liquid, flammable solid, organic peroxide, oxidizer, pyrophoric or unstable (reactive) or water-reactive material.

**PRESSURE VESSEL.** A closed vessel designed to operate at pressures above 103 kPa.

**SAFETY CAN.** An approved container of not more than 19 L capacity having a spring-closing lid and spout cover so designed that it will relieve internal pressure when subjected to fire exposure.

**SECONDARY CONTAINMENT.** That level of containment that is external to and separate from primary containment.

**SEGREGATED.** Storage in the same room or inside area, but physically separated by distance from incompatible materials.

**SOLID.** A material that has a melting point and decomposes or sublimates at a temperature greater than 20°C.

**STORAGE, HAZARDOUS MATERIALS.** The keeping, retention or leaving of hazardous materials in closed containers, tanks, cylinders, or similar vessels; or vessels supplying operations through closed connections to the vessel.

**SYSTEM.** An assembly of equipment consisting of a container or containers, appurtenances, pumps, compressors and connecting piping.

**TANK, ATMOSPHERIC.** A storage tank designed to operate at pressures from 760 mm Hg through 812 mm Hg measured at the top of the tank.

**TANK, PORTABLE.** A packaging of more than 227 L capacity and designed primarily to be loaded into or on or temporarily attached to a transport vehicle or ship and equipped with skids, mountings or accessories to facilitate handling of the tank by mechanical means. It does not include any cylinder having less than a 454 kg water capacity, cargo tank, tank car tank or trailers carrying cylinders of more than 454 kg water capacity.

**TANK, STATIONARY.** Packaging designed primarily for stationary installations not intended for loading, unloading or attachment to a transport vehicle as part of its normal operation in the process of use. It does not include cylinders having less than a 454 kg water capacity.

**TANK VEHICLE.** A vehicle other than a railroad tank car or boat, with a cargo tank mounted thereon or built as an integral part thereof, used for the transportation of flammable or combustible liquids, LP-gas or hazardous chemicals. Tank vehicles include self-propelled vehicles and full trailers and semi-trailers, with or without motive power, and carrying part or all of the load.

**UNAUTHORIZED DISCHARGE.** A release or emission of materials in a manner which does not conform to the provisions of this code requirements or applicable public health and safety regulations.

**USE (MATERIAL).** Placing a material into action, including solids, liquids and gases.

**VAPOR PRESSURE.** The pressure exerted by a volatile fluid as determined in accordance with ASTM D 323.

### SECTION 25.3 GENERAL REQUIREMENTS

- 25.3.1 Scope.** The storage, use and handling of all hazardous materials shall be in accordance with this section.
- 25.3.1.1 Maximum allowable quantity per control area.** The maximum allowable quantity per control area shall be as specified in Tables 25.3.1.1(1) through 25.3.1.1(4).  
For retail and wholesale storage and display in Group M occupancies and Group S storage, see Section 25.3.11.
- 25.3.1.2 Conversion.** Where quantities are indicated in kilograms and when the weight per liters of the liquid is not provided to the building code official, a conversion of 1.2 kg/L shall be used.
- 25.3.1.3 Quantities not exceeding the maximum allowable quantity per control area.** The storage, use and handling of hazardous materials in quantities not exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(1) through 25.3.1.1(4) shall be in accordance with Sections 25.1 and 25.3.
- 25.3.1.4 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of hazardous materials in quantities exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(1) through 25.3.1.1(4) shall be in accordance with this chapter.

**TABLE 25.3.1.1(1)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD**<sup>a, j, m, n</sup>

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE <sup>b</sup>			USE-CLOSED SYSTEMS <sup>b</sup>			USE-OPEN SYSTEMS <sup>b</sup>		
			Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	
Combustible liquid <sup>c, i</sup>	II	H-2 or H-3	Not	454 <sup>d, e</sup>	Not	Not	454 <sup>d</sup>	Not	Not	114 <sup>d</sup>	
	IIIA IIIB	H-2 or H-3 Not Applicable	Applicable	1,249 <sup>d, e</sup> 49,962 <sup>e, f</sup>	Applicable	Applicable	1,249 <sup>d</sup> 49,962 <sup>f</sup>	Applicable	Applicable	303 <sup>d</sup> 12,491 <sup>f</sup>	
Combustible fiber	Loose Baled	H-3	(2.8) (28)	Not Applicable	Not Applicable	(2.8) (28)	Not Applicable	Not Applicable	(0.57) (5.7)	Not Applicable	
Cryogenic Flammable	Not Applicable	H-2	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	38 <sup>d</sup>	
Consumer fireworks (Class C Common)	1.4G	H-3	56.8 <sup>d, e, i</sup>	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	
Cryogenic Oxidizing	Not Applicable	H-3	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	170 <sup>d</sup>	Not Applicable	Not Applicable	38 <sup>d</sup>	
Explosives	Division 1.1	H-1	0.45 <sup>e, g</sup>	(0.45) <sup>e, g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	
	Division 1.2	H-1	0.45 <sup>e, g</sup>	(0.45) <sup>e, g</sup>		0.114 <sup>g</sup>	(0.114) <sup>g</sup>		0.114 <sup>g</sup>	(0.114) <sup>g</sup>	
	Division 1.3	H-1 or H-2	2.3 <sup>e, g</sup>	(2.3) <sup>e, g</sup>		0.45 <sup>g</sup>	(0.45) <sup>g</sup>		0.45 <sup>g</sup>	(0.45) <sup>g</sup>	
	Division 1.4	H-3	22.7 <sup>e, g</sup>	(22.7) <sup>e, g</sup>		22.7 <sup>g</sup>	(22.7) <sup>g</sup>		Not Applicable	Not Applicable	
	Division 1.4G	H-3	56.8 <sup>d, e, i</sup>	Not Applicable		Not Applicable	Not Applicable		Not Applicable	Not Applicable	
	Division 1.5 Division 1.6	H-1 H-1	0.45 <sup>e, g</sup> 0.45 <sup>d, e, g</sup>	(0.45) <sup>e, g</sup> Not Applicable		0.114 <sup>g</sup> Not Applicable	(0.114) <sup>g</sup> Not Applicable		0.114 <sup>g</sup> Not Applicable	(0.114) <sup>g</sup> Not Applicable	
Flammable gas	Gaseous Liquefied	H-2	Not Applicable	Not Applicable 114 <sup>d, e</sup>	28 <sup>d, e</sup> Not Applicable	Not Applicable	Not Applicable 114 <sup>d, e</sup>	28 <sup>d, e</sup> Not Applicable	Not Applicable	Not Applicable	
Flammable liquids <sup>c</sup>	IA IB and IC	H-2 or H-3	Not Applicable	114 <sup>d, e</sup> 454 <sup>d, e</sup>	Not Applicable	Not Applicable	114 <sup>d</sup> 454 <sup>d</sup>	Not Applicable	Not Applicable	38 <sup>d</sup> 114 <sup>d</sup>	
Combination Flammable liquid (IA, IB, IC)	Not Applicable	H2 or H-3	Not Applicable	454 <sup>d, e, h</sup>	Not Applicable	Not Applicable	454 <sup>d, h</sup>	Not Applicable	Not Applicable	114 <sup>d, h</sup>	
Flammable solid	Not Applicable	H-3	54.5 <sup>d, e</sup>	Not Applicable	Not Applicable	56.8 <sup>d</sup>	Not Applicable	Not Applicable	11.4 <sup>d</sup>	Not Applicable	
Organic peroxide	UD	H-1	0.45 <sup>e, g</sup>	(0.45) <sup>e, g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	Not Applicable	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	
	I	H-2	2.3 <sup>d, e</sup>	(2.3) <sup>d, e</sup>		0.45 <sup>d</sup>	(0.45) <sup>d</sup>		0.45 <sup>d</sup>	(0.45) <sup>d</sup>	
	II	H-3	22.7 <sup>d, e</sup>	(22.7) <sup>d, e</sup>		22.7 <sup>d</sup>	(22.7) <sup>d</sup>		4.5 <sup>d</sup>	(4.5) <sup>d</sup>	
	III	H-3	56.8 <sup>d, e</sup>	(56.8) <sup>d, e</sup>		56.8 <sup>d</sup>	(56.8) <sup>d</sup>		11.4 <sup>d</sup>	(11.4) <sup>d</sup>	
	IV V	Not Applicable Not Applicable	Not limited Not limited	Not limited Not limited		Not limited Not limited	Not limited Not limited		Not limited Not limited	Not limited Not limited	

(continued)

TABLE 25.3.1.1(1)—(continued)

**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD**<sup>a, j, m, n</sup>

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE <sup>b</sup>			USE-CLOSED SYSTEMS <sup>b</sup>			USE-OPEN SYSTEMS <sup>b</sup>	
			Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs (cubic meters)	Liquid liters (kgs)
Oxidizer	4	H-1	0.45 <sup>g</sup>	(0.45) <sup>c, g</sup>		0.114 <sup>g</sup>	(0.114) <sup>g</sup>		0.114 <sup>g</sup>	(0.114) <sup>g</sup>
	3 <sup>k</sup>	H-2	4.5 <sup>d, e</sup>	(4.5) <sup>d, e</sup>	Not	0.9 <sup>d</sup>	(0.9) <sup>d</sup>	Not	0.9 <sup>d</sup>	(0.9) <sup>d</sup>
	2	H-3	113.5 <sup>d, e</sup>	(113.5) <sup>d, e</sup>	Applicable	113.5 <sup>d</sup>	(113.5) <sup>d</sup>	Applicable	22.7 <sup>d</sup>	(22.7) <sup>d</sup>
	1	H-3	1,816 <sup>e, f</sup>	(1,816) <sup>e, f</sup>		1,816 <sup>f</sup>	(1,816) <sup>f</sup>		454 <sup>f</sup>	(454) <sup>f</sup>
Oxidizing gas	Gaseous Liquefied	H-3	Not Applicable	Not Applicable 57 <sup>d, e</sup>	42.5 <sup>d, e</sup> Not Applicable	Not Applicable	Not Applicable 57 <sup>d, e</sup>	42.5 <sup>d, e</sup> Not Applicable	Not Applicable	Not Applicable
Pyrophoric	Not Applicable	H-2	1.8 <sup>e, g</sup>	(1.8) <sup>e, g</sup>	1.42 <sup>e, g</sup>	0.45 <sup>g</sup>	(0.45) <sup>g</sup>	0.28 <sup>e, g</sup>	0	0
Unstable (reactive)	4	H-1	0.45 <sup>c, g</sup>	(0.45) <sup>c, g</sup>	0.28 <sup>c, g</sup>	0.114 <sup>g</sup>	(0.114) <sup>g</sup>	0.057 <sup>c, g</sup>	0.114 <sup>g</sup>	(0.114) <sup>g</sup>
	3	H-1 or H-2	2.3 <sup>d, e</sup>	(2.3) <sup>d, e</sup>	1.42 <sup>d, e</sup>	0.45 <sup>d</sup>	(0.45) <sup>d</sup>	0.28 <sup>d, e</sup>	0.45 <sup>d</sup>	(0.45) <sup>d</sup>
	2	H-3	22.7 <sup>d, e</sup>	(22.7) <sup>d, e</sup>	7.1 <sup>d, e</sup>	22.7 <sup>d</sup>	(22.7) <sup>d</sup>	7.1 <sup>d, e</sup>	4.5 <sup>d</sup>	(4.5) <sup>d</sup>
	1	Not Applicable	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited
Water reactive	3	H-2	2.3 <sup>d, e</sup>	(2.3) <sup>d, e</sup>	Not	2.3 <sup>d</sup>	(2.3) <sup>d</sup>	Not	0.45 <sup>d</sup>	(0.45) <sup>d</sup>
	2	H-3	22.7 <sup>d, e</sup>	(22.7) <sup>d, e</sup>	Applicable	22.7 <sup>d</sup>	(22.7) <sup>d</sup>	Applicable	4.5 <sup>d</sup>	(4.5) <sup>d</sup>
	1	Not Applicable	Not Limited	Not Limited		Not Limited	Not Limited		Not Limited	Not Limited

a. For use of control areas, see Section 25.3.8.3.

b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

c. The quantities of medicines, foodstuffs, consumer or industrial products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable shall not be limited, provided that such materials are packaged in individual containers not exceeding 5 liters.

d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

e. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets, exhausted enclosures or safety cans. Where Note d also applies, the increase for both notes shall be applied accumulatively.

f. Quantities shall not be limited in a building equipped throughout with an approved automatic sprinkler system.

g. Allowed only in buildings equipped throughout with an approved automatic sprinkler system.

h. Containing not more than the maximum allowable quantity per control area of Class IA, Class IB or Class IC flammable liquids.

i. Inside a building, the maximum capacity of a combustible liquid storage system that is connected to a fuel-oil piping system shall be 2,498 liters provided such system conforms to this code.

j. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.

k. A maximum quantity of 91 kilograms of solid or 76 liters of liquid Class 3 oxidizers is allowed when such materials are necessary for maintenance purposes, operation or sanitation of equipment when the storage containers and the manner of storage are approved.

l. Net weight of pyrotechnic composition of the fireworks. Where the net weight of the pyrotechnic composition of the fireworks is not known, 25 percent of the gross weight of the fireworks including packaging shall be used.

m. For liters of liquids, divide the amount in kilograms by 1.2 in accordance with Section 25.3.1.2.

n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 25.3.1.1, see Table 25.3.11.1.

**TABLE 25.3.1.1(2)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD<sup>a,b,c,j</sup>**

MATERIAL	STORAGE <sup>d</sup>			USE-CLOSED SYSTEMS <sup>b</sup>			USE-OPEN SYSTEMS <sup>b</sup>	
	Solid kgs <sup>e, f</sup>	Liquid liters (kgs) <sup>g, f</sup>	Gas cubic meters <sup>e</sup>	Solid kgs <sup>e</sup>	Liquid liters (kgs) <sup>e</sup>	Gas cubic meters <sup>e</sup>	Solid kgs <sup>e</sup>	Liquid liters (kgs) <sup>e</sup>
Corrosive	2,270	1,893	23 <sup>f, g</sup>	2,270	1,893	23 <sup>f, g</sup>	454	379
Highly toxic	4.5	(4.5) <sup>i</sup>	0.57 <sup>h</sup>	4.5	(4.5) <sup>i</sup>	0.57 <sup>h</sup>	1.4	(1.4) <sup>i</sup>
Toxic	227	(227) <sup>j</sup>	23 <sup>f</sup>	227	(227) <sup>j</sup>	23 <sup>f</sup>	56.8	(56.8) <sup>j</sup>

a. For use of control areas, see Section 25.3.8.3.

b. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs consumer or industrial products, and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 5 liters.

c. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 25.3.11, see Table 25.3.11.1.

d. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

e. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. Where Note f also applies, the increase for both notes shall be applied accumulatively.

f. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets, or exhausted enclosures. Where Note e also applies, the increase for both notes shall be applied accumulatively.

g. A single cylinder containing 68 kilograms or less of anhydrous ammonia in a single control area in a nonsprinklered building shall be considered a maximum allowable quantity. Two cylinders, each containing 68 kilograms or less in a single control area shall be considered a maximum allowable quantity provided the building is equipped throughout with an automatic sprinkler system in accordance with Section 7.3.3.1.1.

h. Allowed only when stored in approved exhausted gas cabinets or exhausted enclosures.

i. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.

j. For liters of liquids, divide the amount in kilograms by 1.2 in accordance with Section 25.3.1.2.

**TABLE 25.3.1.1(3)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD IN AN**  
**OUTDOOR CONTROL AREA<sup>a, b, c</sup>**

MATERIAL	CLASS	STORAGE <sup>d</sup>			USE-CLOSED SYSTEMS <sup>b</sup>			USE-OPEN SYSTEMS <sup>b</sup>	
		Solid kgs	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs	Liquid liters (kgs)
Flammable gas	Gaseous Liquefied	Not Applicable	Not Applicable 114	85 Not Applicable	Not Applicable	Not Applicable 57	42.5 Not Applicable	Not Applicable	Not Applicable
Flammable solid	Not Applicable	227	Not Applicable	Not Applicable	113.5	Not Applicable	Not Applicable	22.7	Not Applicable
Organic peroxide	Unclassified Detonable	0.45	(0.45)	Not Applicable	0.114	(0.114) <sup>d</sup>	Not Applicable	0.114	(0.114) <sup>d</sup>
Organic peroxide	I	9.1	(9.1) <sup>d</sup>		4.5	(4.5) <sup>d</sup>		0.9	(0.9) <sup>d</sup>
	II	91	(91) <sup>d</sup>		45.4	(45.4) <sup>d</sup>		9.1	(9.1) <sup>d</sup>
	III	227	(227) <sup>d</sup>	Not Applicable	113.5	(113.5) <sup>d</sup>	Not Applicable	22.7	(22.7) <sup>d</sup>
	IV	454	(454) <sup>d</sup>		227	(227) <sup>d</sup>		45.4	(45.4) <sup>d</sup>
	V	Not Limited	Not Limited		Not Limited	Not Limited		Not Limited	Not Limited
Oxidizer	4	0.9	(0.9) <sup>d</sup>		0.45	(0.45) <sup>d</sup>		0.114	(0.114) <sup>d</sup>
	3	18.2	(18.2) <sup>d</sup>		9.1	(9.1) <sup>d</sup>		1.8	(1.8) <sup>d</sup>
	2	454	(454) <sup>d</sup>	Not Applicable	227	(227) <sup>d</sup>	Not Applicable	45.4	(45.4) <sup>d</sup>
Oxidizing gas	1	Not Limited	Not Limited		Not Limited	Not Limited		Not Limited	Not Limited
	Gaseous Liquefied	Not Applicable	Not Applicable 227	170 Not Applicable	Not Applicable	Not Applicable 114	85 Not Applicable	Not Applicable	Not Applicable
Pyrophoric materials	Not Applicable	3.6	(3.6) <sup>d</sup>	2.8	1.8	(1.8) <sup>d</sup>	0.28	0	0
Unstable (reactive)	4	0.9	(0.9) <sup>d</sup>	0.57	0.45	(0.45) <sup>d</sup>	0.057	0.114	(0.114) <sup>d</sup>
	3	9.1	(9.1) <sup>d</sup>	5.7	4.5	(4.5) <sup>d</sup>	0.28	0.45	3.8
	2	91	(91) <sup>d</sup>	28	45.4	(45.4) <sup>d</sup>	7.1	4.5	38
Water reactive	1	Not Limited	Not Limited	42.5	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited
	3	9.1	(9.1) <sup>d</sup>	Not Applicable	4.5	(4.5) <sup>d</sup>	Not Applicable	0.45	(0.45) <sup>d</sup>
	2	91	(91) <sup>d</sup>		45.4	(45.4) <sup>d</sup>	Not Applicable	4.5	(4.5) <sup>d</sup>
	1	Not Limited	Not Limited		Not Limited	Not Limited		Not Limited	Not Limited

a. For liters of liquids, divide the amount in kilograms by 1.2 in accordance with Section 25.3.1.2.

b. The aggregate quantities in storage and use shall not exceed the quantity listed for storage.

c. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed in outdoor storage per single property under the same ownership or control used for retail or wholesale sales is allowed to exceed the maximum allowable quantity per control area when such storage is in accordance with Section 25.3.11.

d. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

**TABLE 25.3.1.1(4)**  
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD IN AN OUTDOOR**  
**CONTROL AREA<sup>a,b,c</sup>**

MATERIAL	STORAGE <sup>d</sup>			USE-CLOSED SYSTEMS <sup>b</sup>			USE-OPEN SYSTEMS <sup>b</sup>	
	Solid kgs	Liquid liters (kgs)	Gas cubic mters at NTP	Solid kgs	Liquid liters (kgs)	Gas cubic meters at NTP	Solid kgs	Liquid liters (kgs)
Corrosive	9,080	3,785	45.8 <sup>e</sup>	4,540	3,785	23 <sup>e</sup>	454	379
Highly toxics	9.1	(9.1) <sup>f</sup>	1.13 <sup>d</sup>	4.5	(4.5) <sup>f</sup>	0.57 <sup>d</sup>	1.4	(1.4) <sup>f</sup>
Toxic	454	(454) <sup>e,f</sup>	45.8	227	189 <sup>e</sup>	23	11.4	(11.4) <sup>e,f</sup>

a. For liters of liquids, divide the amount in kilograms by 1.2 in accordance with Section 25.3.1.2.

b. The aggregate quantities in storage and use shall not exceed the quantity listed for storage.

c. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed in outdoor storage per single property under the same ownership or control used for retail or wholesale sales is allowed to exceed the maximum allowable quantity per control area when such storage is in accordance with Section 25.3.11.

d. Allowed only when used in approved exhausted gas cabinets, exhausted enclosures or under fume hoods.

e. The maximum allowable quantity per control area for toxic liquids with vapor pressures in excess of 6.9 kPa at 25°C shall be the maximum allowable quantity per control area listed for highly toxic liquids.

f. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

g. Two cylinders, each cylinder containing 68 kilograms or less of anhydrous ammonia, shall be considered a maximum allowable quantity in an outdoor control area.



**25.3.2 Systems, equipment and processes.** Systems, equipment and processes utilized for storage, dispensing, use or handling of hazardous materials shall be in accordance with Sections 25.3.2.1 through 25.3.2.8.

**25.3.2.1 Design and construction of containers, cylinders and tanks.** Containers, cylinders and tanks shall be designed and constructed in accordance with approved standards. Containers, cylinders, tanks and other means used for containment of hazardous materials shall be of an approved type.

**25.3.2.2 Piping, tubing, valves and fittings.** Piping, tubing, valves and fittings conveying hazardous materials shall be designed and installed in accordance with approved standards and shall be in accordance with Sections 25.3.2.2.1 and 25.3.2.2.2.

**25.3.2.2.1 Design and construction.** Piping, tubing, valves, fittings and related components used for hazardous materials shall be in accordance with the following:

1. Piping, tubing, valves, fittings and related components shall be designed and fabricated from materials compatible with the material to be contained and shall be of adequate strength and durability to withstand the pressure, structural and seismic stress, and exposure to which they are subject.
2. Piping and tubing shall be identified in accordance with ANSI A13.1 to indicate the material conveyed.
3. Readily accessible manual valves, or automatic remotely activated fail-safe emergency shutoff valves, shall be installed on supply piping and tubing at the following locations:
  - 3.1 The point of use.
  - 3.2 The tank, cylinder or bulk source.
4. Emergency shutoff valves shall be identified and the location shall be clearly visible and accessible and indicated by means of a sign.
5. Backflow prevention or check valves shall be provided when the backflow of hazardous materials could create a hazardous condition or cause the unauthorized discharge of hazardous materials.
6. Where gases or liquids having a hazard ranking of:

Health hazard Class 3 or 4

Flammability Class 4

Reactivity Class 3 or 4

in accordance with NFPA 704 are carried in pressurized piping above 103 kPa, an approved means of leak detection and emergency shutoff or excess flow control shall be provided. Where the piping originates from within a hazardous material storage room or area, the excess flow control shall be located within the storage room or area. Where the piping originates from a bulk source, the excess flow control shall be located as close to the bulk source as practical.

**Exceptions:**

1. Piping for inlet connections designed to prevent backflow.
2. Piping for pressure relief devices.

**25.3.2.2.2 Additional regulations for supply piping for health-hazard materials.** Supply piping and tubing for gases and liquids having a health-hazard ranking of 3 or 4 in accordance with NFPA 704 shall be in accordance with ANSI B31.3 and the following:

1. Piping and tubing utilized for the transmission of highly toxic, toxic or highly volatile corrosive liquids and gases shall have welded, threaded or flanged connections throughout except for connections located within a ventilated enclosure if the material is a gas, or an approved method of drainage or containment is provided for connections if the material is a liquid.
2. Piping and tubing shall not be located within corridors, within any portion of a means of egress required to be enclosed in fire-resistance-rated construction or

in concealed spaces in areas not classified as Group H occupancies.

**Exception:** Piping and tubing within the space defined by the walls of corridors and the floor or roof above or in concealed spaces above other occupancies when installed in accordance with Section 2.28 of the SBC 201 for Group H-5 occupancies.

- 25.3.2.3 **Equipment, machinery and alarms.** Equipment, machinery and required detection and alarm systems associated with the use, storage or handling of hazardous materials shall be listed or approved.
- 25.3.2.4 **Installation of tanks.** Installation of tanks shall be in accordance with Sections 25.3.2.4.1 through 25.3.2.4.2.1.
- 25.3.2.4.1 **Underground tanks.** Underground tanks used for the storage of liquid hazardous materials shall be provided with secondary containment. In lieu of providing secondary containment for an underground tank, an above-ground tank in an underground vault complying with Section 32.4.2.8 shall be permitted. Underground vaults shall be otherwise regulated as underground tank installations.
- 25.3.2.4.2 **Above-ground tanks.** Above-ground stationary tanks used for the storage of hazardous materials shall be located and protected in accordance with the requirements for outdoor storage of the particular material involved.  
**Exception:** Above-ground tanks that are installed in vaults complying with Section 32.4.2.8 shall not be required to comply with location and protection requirements for outdoor storage.
- 25.3.2.4.2.1 **Marking.** Above-ground stationary tanks shall be marked as required by Section 25.3.5.
- 25.3.2.5 **Empty containers and tanks.** Empty containers and tanks previously used for the storage of hazardous materials shall be free from residual material and vapor as defined by MOI or other regulating authority or maintained as specified for the storage of hazardous material.
- 25.3.2.6 **Maintenance.** In addition to the requirements of Section 25.3.2.3, equipment, machinery and required detection and alarm systems associated with hazardous materials shall be maintained in an operable condition. Defective containers, cylinders and tanks shall be removed from service, repaired or disposed of in an approved manner. Defective equipment or machinery shall be removed from service and repaired or replaced. Required detection and alarm systems shall be replaced or repaired where defective.
- 25.3.2.6.1 **Tanks out of service for 90 days.** Stationary tanks not used for a period of 90 days shall be properly safeguarded or removed in an approved manner. Such tanks shall have the fill line, gauge opening and pump connection secured against tampering. Vent lines shall be properly maintained.
- 25.3.2.6.1.1 **Return to service.** Tanks that are to be placed back in service shall be tested in an approved manner.
- 25.3.2.6.2 **Defective containers and tanks.** Defective containers and tanks shall be removed from service, repaired in accordance with approved standards or disposed of in an approved manner.
- 25.3.2.7 **Liquid-level limit control.** Atmospheric tanks having a capacity greater than 1,893 L and which contain hazardous material liquids shall be equipped with a liquid-level limit control or other approved means to prevent overfilling of the tank.
- 25.3.2.8 **Seismic protection.** Machinery and equipment utilizing hazardous materials shall be braced and anchored in accordance with the seismic design requirements of the SBC 301 for the seismic design category in which the machinery or equipment is classified.

- 25.3.3 Release of hazardous materials.** Hazardous materials in any quantity shall not be released into a sewer, storm drain, ditch, drainage canal, creek, stream, river, lake or tidal waterway or on the ground, sidewalk, street, highway or into the atmosphere.
- Exceptions:**
1. The release or emission of hazardous materials is allowed when in compliance with local governmental agencies, regulations or permits.
  2. The release of pesticides is allowed when used in accordance with registered label directions.
  3. The release of fertilizer and soil amendments is allowed when used in accordance with manufacturer's specifications.
- 25.3.3.1 Unauthorized discharges.** When hazardous materials are released in quantities reportable under local regulations, the building code official shall be notified and the following procedures required in accordance with Sections 25.3.3.1.1 through 25.3.3.1.4.
- 25.3.3.1.1 Records.** Accurate records shall be kept of the unauthorized discharge of hazardous materials by the permittee.
- 25.3.3.1.2 Preparation.** Provisions shall be made for controlling and mitigating unauthorized discharges.
- 25.3.3.1.3 Control.** When an unauthorized discharge caused by primary container failure is discovered, the involved primary container shall be repaired or removed from service.
- 25.3.3.1.4 Responsibility for cleanup.** The person, firm or corporation responsible for an unauthorized discharge shall institute and complete all actions necessary to remedy the effects of such unauthorized discharge, whether sudden or gradual, at no cost to the authority. When deemed necessary by the building code official, cleanup may be initiated by the Civil Defence or by an authorized individual or firm. Costs associated with such cleanup shall be borne by the owner, operator or other person responsible for the unauthorized discharge.
- 25.3.4 Material Safety Data Sheets.** Material Safety Data Sheets (MSDS) shall be readily available on the premises for hazardous materials regulated by this chapter. When a hazardous substance is developed in a laboratory, available information shall be documented.
- Exception:** Designated hazardous waste.
- 25.3.5 Hazard identification signs.** Unless otherwise exempted by the building code official, visible hazard identification signs as specified in NFPA 704 for the specific material contained shall be placed on stationary containers and above-ground tanks and at entrances to locations where hazardous materials are stored, dispensed, used or handled in quantities requiring a permit and at specific entrances and locations designated by the building code official.
- 25.3.5.1 Markings.** Individual containers, cartons or packages shall be conspicuously marked or labeled in an approved manner. Rooms or cabinets containing compressed gases shall be conspicuously labeled: COMPRESSED GAS.
- 25.3.6 Signs.** Signs and markings required by Sections 25.3.5 and 25.3.5.1 shall not be obscured or removed, shall be in English as a primary language or in symbols allowed by the code requirements, shall be durable, and the size, color and lettering shall be approved.
- 25.3.7 Sources of ignition.** Sources of ignition shall comply with Sections 25.3.7.1 through 25.3.7.3.

- 25.3.7.1 Smoking.** Smoking shall be prohibited and “No Smoking” signs provided as follows:
1. In rooms or areas where hazardous materials are stored or dispensed or used in open systems in amounts requiring a permit in accordance with Section 25.1.2.1.
  2. Within 7.6 m of outdoor storage, dispensing or open use areas.
  3. Facilities or areas within facilities that have been designated as totally “no smoking” shall have “No Smoking” signs placed at all entrances to the facility or area. Designated areas within such facilities where smoking is permitted either permanently or temporarily shall be identified with signs designating that smoking is permitted in these areas only.
  4. In rooms or areas where flammable or combustible hazardous materials are stored, dispensed or used. Signs required by this section shall be in English as a primary language or in symbols allowed by the code requirements and shall comply with Section 5A.10.
- 25.3.7.2 Open flames.** Open flames and high-temperature devices shall not be used in a manner which creates a hazardous condition and shall be listed for use with the hazardous materials stored or used.
- 25.3.7.3 Industrial trucks.** Powered industrial trucks used in areas designated as hazardous (classified) locations in accordance with the SBC 401 shall be listed and labeled for use in the environment intended in accordance with NFPA 505.
- 25.3.8 Construction requirements.** Buildings, control areas, enclosures and cabinets for hazardous materials shall be in accordance with Sections 25.3.8.1 through 25.3.8.6.2.
- 25.3.8.1 Buildings.** Buildings or portions thereof, in which hazardous materials are stored, handled or used shall be constructed in accordance with the SBC 201.
- 25.3.8.2 Required detached buildings.** Group H occupancies containing quantities of hazardous materials in excess of those set forth in Table 25.3.8.2 shall be in detached buildings.
- 25.3.8.3 Control areas.** Control areas shall be those spaces within a building and outdoor areas where quantities of hazardous materials not exceeding the maximum quantities allowed by the code requirements are stored, dispensed, used or handled.
- 25.3.8.3.1 Construction requirements.** Control areas shall be separated from each other by not less than a 1 hour fire barrier constructed in accordance with the code requirements.
- 25.3.8.3.2 Number.** The maximum number of control areas within a building shall be in accordance with Table 25.3.8.3.2.
- 25.3.8.3.3 Separation.** The required fire-resistance rating for fire barrier assemblies shall be in accordance with Table 25.3.8.3.2. The floor construction of the control area and construction supporting the floor of the control area shall have a minimum 2 hours fire-resistance rating.
- 25.3.8.3.4 Hazardous materials in Group M and S occupancies.** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed within a single control area of a Group M or S occupancy is allowed to exceed the maximum allowable quantities specified in Tables 25.3.1.1(1) and 25.3.1.1(2) without classifying the building or use as a Group H occupancy, provided that the materials are stored in accordance with Section 25.3.11.

- 25.3.8.4 Gas rooms.** Where a gas room is provided to comply with the provisions of Chapter 35, the gas room shall be in accordance with Sections 25.3.8.4.1 and 25.3.8.4.2.
- 25.3.8.4.1 Construction.** Gas rooms shall be protected with an automatic sprinkler system. Gas rooms shall be separated from the remainder of the building in accordance with the requirements of the SBC based on the occupancy group into which it has been classified.
- 25.3.8.4.2 Ventilation system.** The ventilation system for gas rooms shall be designed to operate at a negative pressure in relation to the surrounding area. Highly toxic and toxic gases shall also comply with Section 35.4.2.2.6. The ventilation system shall be installed in accordance with the SBC 501.
- 25.3.8.5 Exhausted enclosures.** Where an exhausted enclosure is used to increase maximum allowable quantity per control area or when the location of hazardous materials in exhausted enclosures is provided to comply with the provisions of Chapter 35, the exhausted enclosure shall be in accordance with Sections 25.3.8.5.1 through 25.3.8.5.3.

**TABLE 25.3.8.2  
REQUIRED DETACHED STORAGE**

<b>DETACHED STORAGE IS REQUIRED WHEN THE QUANTITY OF MATERIAL EXCEEDS THAT LISTED HEREIN</b>			
<b>Material</b>	<b>Class</b>	<b>Solids and liquids (tones)<sup>a,b</sup></b>	<b>Gases (cubic meters)<sup>a,b</sup></b>
Explosives	Division 1.1	Maximum Allowable Quantity	Not Applicable
	Division 1.2	Maximum Allowable Quantity	
	Division 1.3	Maximum Allowable Quantity	
	Division 1.4	Maximum Allowable Quantity	
	Division 1.4 <sup>c</sup>	0.91	
	Division 1.5	Maximum Allowable Quantity	
	Division 1.7	Maximum Allowable Quantity	
Oxidizers	Class 4	Maximum Allowable Quantity	Maximum Allowable Quantity
Unstable (reactives) detonable	Class 3 or 4	Maximum Allowable Quantity	Maximum Allowable Quantity
Oxidizer, liquids and solids	Class 3	1,089	Not Applicable
	Class 2	1,814	
Organic peroxides	Detonable	Maximum Allowable Quantity	Not Applicable
	Class I	Maximum Allowable Quantity	
	Class II	22.7	
	Class III	45.4	
Unstable (reactives) nondetonable	Class 3	0.91	57
	Class 2	22.7	283
Water reactives	Class 3	0.91	Not Applicable
	Class 2	22.7	
Pyrophoric gases	Not Applicable	Not Applicable	57

- a. For materials which are detonable, the distance to other buildings or lot lines shall be as specified in the SBC 201. For materials classified as explosives, the required separation distances shall be as specified in Chapter 31.
- b. "Maximum Allowable Quantity" means the maximum allowable quantity per control area set forth in Table 25.3.1.1(1).
- c. Limited to Division 1.4 materials and articles, including articles packaged for shipment, that are not regulated as an explosive under MOI regulations, or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, providing the net explosive weight of individual articles does not exceed 0.45 k.

**TABLE 25.3.8.3.2**  
**DESIGN AND NUMBER OF CONTROL AREAS**

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA <sup>a</sup>	NUMBER OF CONTROL AREAS PER FLOOR <sup>b</sup>	FIRE- RESISTANCE RATING FOR FIRE BARRIERS IN HOURS <sup>c</sup>
Above grade	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade	1	75	3	1
	2	50	2	1
	Lower than 2	Not Applicable	Not Applicable	Not Applicable

- Percentages shall be of the maximum allowable quantity per control area shown in Tables 25.3.1.1(1) and 25.3.1.1(2), with all increases allowed in the footnotes to those tables.
- There shall be a maximum of two control areas per floor in Group M occupancies and in buildings or portions of buildings having Group S occupancies with storage conditions and quantities in accordance with Section 25.3.11.
- Fire barriers shall include walls and floors as necessary to provide separation from other portions of the building.

**25.3.8.5.1 Construction.** Exhausted enclosures shall be of noncombustible construction.

**25.3.8.5.2 Ventilation.** The ventilation system for exhausted enclosures shall be designed to operate at a negative pressure in relation to the surrounding area. Ventilation systems used for highly toxic and toxic gases shall also comply with Items 1, 2 and 3 of Section 35.4.1.2. The ventilation system shall be installed in accordance with the SBC 501.

**25.3.8.5.3 Fire-extinguishing system.** Exhausted enclosures where flammable materials are used shall be protected by an approved automatic fire-extinguishing system in accordance with Chapter 7.

**25.3.8.6 Gas cabinets.** Where a gas cabinet is used to increase the maximum allowable quantity per control area or when the location of compressed gases in gas cabinets is provided to comply with the provisions of Chapter 35, the gas cabinet shall be in accordance with Sections 25.3.8.6.1 through 25.3.8.6.3.

**25.3.8.6.1 Construction.** Gas cabinets shall be constructed in accordance with the following:

- Constructed of not less than 2.5 mm steel.
- Be provided with self-closing limited access ports or noncombustible windows to give access to equipment controls.
- Be provided with self-closing doors.
- Gas cabinet interiors shall be treated, coated or constructed of materials that are compatible with the hazardous materials stored. Such treatment, coating or construction shall include the entire interior of the cabinet.

**25.3.8.6.2 Ventilation.** The ventilation system for gas cabinets shall be designed to operate at a negative pressure in relation to the surrounding area. Ventilation systems used for highly toxic and toxic gases shall also comply with Items 1, 2 and 3 of Section 35.4.1.2. The ventilation system shall be installed in accordance with the SBC 501.

- 25.3.8.6.3 Maximum number of cylinders per gas cabinet.** The number of cylinders contained in a single gas cabinet shall not exceed three.
- 25.3.8.7 Hazardous materials storage cabinets.** Where storage cabinets are used to increase maximum allowable quantity per control area or to comply with this chapter, such cabinets shall be in accordance with Sections 25.3.8.7.1 and 25.3.8.7.2.
- 25.3.8.7.1 Construction.** The interior of cabinets shall be treated, coated or constructed of materials that are non-reactive with the hazardous material stored. Such treatment, coating or construction shall include the entire interior of the cabinet. Cabinets shall either be listed in accordance with UL 1275 as suitable for the intended storage or constructed in accordance with the following:
- 1.** Cabinets shall be of steel having a thickness of not less than 1.2 mm. The cabinet, including the door, shall be double walled with a 38 mm airspace between the walls. Joints shall be riveted or welded and shall be tight fitting. Doors shall be well fitted, self-closing and equipped with a self-latching device.
  - 2.** The bottoms of cabinets utilized for the storage of liquids shall be liquid tight to a minimum height of 51 mm.
- Electrical equipment and devices within cabinets used for the storage of hazardous gases or liquids shall be in accordance with the SBC 401.
- 25.3.8.7.2 Warning markings.** Cabinets shall be clearly identified in an approved manner with red letters on a contrasting background to read:

#### HAZARDOUS — KEEP FIRE AWAY

- 25.3.9 General safety precautions.** General precautions for the safe storage, handling or care of hazardous materials shall be in accordance with Sections 25.3.9.1 through 25.3.9.9.
- 25.3.9.1 Personnel training and written procedures.** Persons responsible for the operation of areas in which hazardous materials are stored, dispensed, handled or used shall be familiar with the chemical nature of the materials and the appropriate mitigating actions necessary in the event of fire, leak or spill.
- 25.3.9.1.1 Civil Defence liaison.** Responsible persons shall be designated and trained to be liaison personnel to the Civil Defence. These persons shall aid the Civil Defence in preplanning emergency responses and identifying the locations where hazardous materials are located, and shall have access to Material Safety Data Sheets and be knowledgeable in the site's emergency response procedures.
- 25.3.9.2 Security.** Storage, dispensing, use and handling areas shall be secured against unauthorized entry and safeguarded in a manner approved by the building code official.
- 25.3.9.3 Protection from vehicles.** Guard posts or other approved means shall be provided to protect storage tanks and connected piping, valves and fittings; dispensing areas; and use areas subject to vehicular damage in accordance with Section 5A.12.
- 25.3.9.4 Electrical wiring and equipment.** Electrical wiring and equipment shall be installed and maintained in accordance with the SBC 401.
- 25.3.9.5 Static accumulation.** When processes or conditions exist where a flammable mixture could be ignited by static electricity, means shall be provided to prevent the accumulation of a static charge.
- 25.3.9.6 Protection from light.** Materials that are sensitive to light shall be stored in containers designed to protect them from such exposure.
- 25.3.9.7 Shock padding.** Materials that are shock sensitive shall be padded, suspended or

otherwise protected against accidental dislodgement and dislodgement during seismic activity.

**25.3.9.8 Separation of incompatible materials.** Incompatible materials in storage and storage of materials that are incompatible with materials in use shall be separated when the stored materials are in containers having a capacity of more than 2 kg or 2 L. Separation shall be accomplished by:

1. Segregating incompatible materials in storage by a distance of not less than 6.1 m.
2. Isolating incompatible materials in storage by a noncombustible partition extending not less than 457 mm above and to the sides of the stored material.
3. Storing liquid and solid materials in hazardous material storage cabinets.
4. Storing compressed gases in gas cabinets or exhausted enclosures in accordance with Sections 25.3.8.5 and 25.3.8.6. Materials that are incompatible shall not be stored within the same cabinet or exhausted enclosure.

**25.3.9.9 Shelf storage.** Shelving shall be of substantial construction, and shall be braced and anchored in accordance with the seismic design requirements of the SBC 301 for the seismic zone in which the material is located. Shelving shall be treated, coated or constructed of materials that are compatible with the hazardous materials stored. Shelves shall be provided with a lip or guard when used for the storage of individual containers.

**Exceptions:**

1. Storage in hazardous material storage cabinets or laboratory furniture specifically designed for such use.
2. Storage of hazardous materials in amounts not requiring a permit in accordance with Section 25.1.5.

Shelf storage of hazardous materials shall be maintained in an orderly manner.

**25.3.10 Handling and transportation.** In addition to the requirements of Section 25.3.2, the handling and transportation of hazardous materials in corridors or exit enclosures shall be in accordance with Sections 25.3.10.1 through 25.3.10.3.6.

**25.3.10.1 Valve protection.** Hazardous material gas containers, cylinders and tanks in transit shall have their protective caps in place. Containers, cylinders and tanks of highly toxic or toxic compressed gases shall have their valve outlets capped or plugged with an approved closure device in accordance with Chapter 28.

**25.3.10.2 Carts and trucks required.** Liquids in containers exceeding 19 L in a corridor or exit enclosure shall be transported on a cart or truck. Containers of hazardous materials having a hazard ranking of 3 or 4 in accordance with NFPA 704 and transported within corridors or exit enclosures, shall be on a cart or truck. Where carts and trucks are required for transporting hazardous materials, they shall be in accordance with Section 25.3.10.3.

**Exceptions:**

1. Two hazardous material liquid containers, which are hand carried in acceptable safety carriers.
2. Not more than four drums not exceeding 208 L each, which are transported by suitable drum trucks.
3. Containers and cylinders of compressed gases, which are transported by approved hand trucks, and containers and cylinders not exceeding 11 kg, which are hand carried.
4. Solid hazardous materials not exceeding 45 kg, which are transported by approved hand trucks, and a single container not exceeding 23 kg, which is hand carried.



- 25.3.10.3 Carts and trucks.** Carts and trucks required by Section 25.3.10.2 to be used to transport hazardous materials shall be in accordance with Sections 25.3.10.3.1 through 25.3.10.3.6.
- 25.3.10.3.1 Design.** Carts and trucks used to transport hazardous materials shall be designed to provide a stable base for the commodities to be transported and shall have a means of restraining containers to prevent accidental dislodgement. Compressed gas cylinders placed on carts and trucks shall be individually restrained.
- 25.3.10.3.2 Speed-control devices.** Carts and trucks shall be provided with a device that will enable the operator to control safely movement by providing stops or speed-reduction devices.
- 25.3.10.3.3 Construction.** Construction materials for hazardous material carts or trucks shall be compatible with the material transported. The cart or truck shall be of substantial construction.
- 25.3.10.3.4 Spill control.** Carts and trucks transporting liquids shall be capable of containing a spill from the largest single container transported.
- 25.3.10.3.5 Attendance.** Carts and trucks used to transport materials shall not obstruct or be left unattended within any part of a means of egress.
- 25.3.10.3.6 Incompatible materials.** Incompatible materials shall not be transported on the same cart or truck.
- 25.3.11 Group M storage and display and Group S storage.** The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored and displayed within a single control area of a Group M occupancy, or an outdoor control area, or stored in a single control area of a Group S occupancy, is allowed to exceed the maximum allowable quantity per control area indicated in Section 25.3.1 when in accordance with Sections 25.3.11.1 through 25.3.11.3.10.
- 25.3.11.1 Maximum allowable quantity per control area in Group M or S occupancies.** The aggregate amount of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored and displayed within a single control area of a Group M occupancy or stored in a single control area of a Group S occupancy shall not exceed the amounts set forth in Table 25.3.11.1.
- 25.3.11.2 Maximum allowable quantity per outdoor control area in Group M or S occupancies.** The aggregate amount of nonflammable solid and nonflammable or noncombustible liquid hazardous materials stored and displayed within a single outdoor control area of a Group M occupancy shall not exceed the amounts set forth in Table 25.3.11.1.
- 25.3.11.3 Storage and display.** Storage and display shall be in accordance with Sections 25.3.11.3.1 through 25.3.11.3.10.
- 25.3.11.3.1 Density.** Storage and display of solids shall not exceed  $976 \text{ kg/m}^2$  of floor area actually occupied by solid merchandise. Storage and display of liquids shall not exceed  $0.50 \text{ L/m}^2$  of floor area actually occupied by liquid merchandise.
- 25.3.11.3.2 Storage and display height.** Display height shall not exceed 1.8 m above the finished floor in display areas of Group M occupancies. Storage height shall not exceed 2.4 m above the finished floor in storage areas of Group M and Group S occupancies.
- 25.3.11.3.3 Container location.** Individual containers less than 19 L or less than 11 kg shall be stored or displayed on pallets, racks or shelves.
- 25.3.11.3.4 Racks and shelves.** Racks and shelves used for storage or display shall be in accordance with Section 25.3.9.9.
- 25.3.11.3.5 Container type.** Containers shall be approved for the intended use and identified as to their content.

- 25.3.11.3.6 Container size.** Individual containers shall not exceed 45 kg for solids or 38 L for liquids in storage and display areas.
- 25.3.11.3.7 Incompatible materials.** Incompatible materials shall be separated in accordance with Section 25.3.9.8.
- 25.3.11.3.8 Floors.** Floors shall be in accordance with Section 25.4.12.
- 25.3.11.3.9 Aisles.** Aisles 1.2 m in width shall be maintained on three sides of the storage or display area.
- 25.3.11.3.10 Signs.** Hazard identification signs shall be provided in accordance with Section 25.3.5.

**TABLE 25.3.11.1**  
**MAXIMUM ALLOWABLE QUANTITY PER INDOOR AND OUTDOOR CONTROL AREA**  
**IN GROUP M AND S OCCUPANCIES NONFLAMMABLE SOLIDS, NONFLAMMABLE**  
**AND NONCOMBUSTIBLE LIQUIDS<sup>d, e, f</sup>**

CONDITION		MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA	
Material <sup>a</sup>	Class	Solids kgs	Liquid liters
<b>A. HEALTH-HAZARD MATERIALS–NONFLAMMABLE AND NONCOMBUSTIBLE SOLIDS AND LIQUIDS</b>			
1. Corrosives <sup>b, c</sup>	Not Applicable	4,427	3,690
2. Highly Toxics	Not Applicable	9.1 <sup>b, c</sup>	7.6 <sup>b, c</sup>
3. Toxics <sup>b, c</sup>	Not Applicable	454	379
<b>B. PHYSICAL-HAZARD MATERIALS–NONFLAMMABLE AND NONCOMBUSTIBLE SOLIDS AND LIQUIDS</b>			
1. Oxidizers <sup>b, c</sup>	4	Not Allowed	Not Allowed
	3	522 <sup>g</sup>	435
	2	1,022 <sup>h</sup>	852
	1	8,172 <sup>i, j</sup>	6,813 <sup>i, j</sup>
2. Unstable (Reactives) <sup>b, c</sup>	4	Not Allowed	Not Allowed
	3	250	208
	2	522	435
	1	Not Limited	Not Limited
3. Water (Reactives)	3 <sup>b, c</sup>	250	208
	2 <sup>b, c</sup>	522	435
	1	Not Limited	Not Limited

- a. Hazard categories are as specified in Section 25.1.2.2.
- b. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. When Note c also applies, the increase for both notes shall be applied cumulatively.
- c. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets in accordance with Section 25.3.8. When Note b also applies, the increase for both notes shall be applied cumulatively.
- d. See Table 25.3.8.3.2 for design and number of control areas.
- e. Allowable quantities for other hazardous material categories shall be in accordance with Section 25.3.1.
- f. Maximum quantities shall be increased 100 percent in outdoor control areas.
- g. Maximum amounts are permitted to be increased to 1,022 kg when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 4.5 kilograms each.
- h. Maximum amounts are permitted to be increased to 2,043 kg when individual packages are in the original sealed containers from the manufacturer or packager and do not exceed 4.5 kg each.
- i. Quantities are unlimited where protected by an automatic sprinkler system.
- j. Quantities are unlimited in an outdoor control area.

**25.3.12 Outdoor control areas.** Outdoor control areas for hazardous materials in amounts not exceeding the maximum allowable quantity per outdoor control area shall be in accordance with the following:

1. Outdoor control area shall be kept free from weeds, debris and common combustible materials not necessary to the storage. The area surrounding an outdoor control area shall be kept clear of such materials for a minimum of 4.6 m.
2. Outdoor control areas shall be located not closer than 6.1 m from a lot line that can be built upon, public street, public alley or public way. A 2 hours fire-resistance-rated wall without openings extending not less than 762 mm above and to the sides of the storage area is allowed in lieu of such distance.
3. Where a property exceeds 929 m<sup>2</sup>, a group of two outdoor control areas is allowed when approved and when each control area is separated by a minimum distance of 15.3 m.
4. Where a property exceeds 3,252 m<sup>2</sup>, additional groups of outdoor control areas are allowed when approved and when each group is separated by a minimum distance of 91.5 m.

## SECTION 25.4 STORAGE

**25.4.1 Scope.** Storage of hazardous materials in amounts exceeding the maximum allowable quantity per control area as set forth in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3 and 25.4. Storage of hazardous materials in amounts not exceeding the maximum allowable quantity per control area as set forth in Section 25.3.1 shall be in accordance with Sections 25.1 and 25.3. Retail and wholesale storage and display of nonflammable solid and nonflammable and noncombustible liquid hazardous materials in Group M occupancies and Group S storage shall be in accordance with Section 25.3.11.

**25.4.2 Spill control and secondary containment for liquid and solid hazardous materials.** Rooms, buildings or areas used for the storage of liquid or solid hazardous materials shall be provided with spill control and secondary containment in accordance with Sections 25.4.2.1 through 25.4.2.3.

**Exception:** Outdoor storage of containers on approved containment pallets in accordance with Section 25.4.2.3.

**25.4.2.1 Spill control for hazardous material liquids.** Rooms, buildings or areas used for the storage of hazardous material liquids in individual vessels having a capacity of more than 208 L, or in which the aggregate capacity of multiple vessels exceeds 3,785 L, shall be provided with spill control to prevent the flow of liquids to adjoining areas. Floors in indoor locations and similar surfaces in outdoor locations shall be constructed to contain a spill from the largest single vessel by one of the following methods:

1. Liquid-tight sloped or recessed floors in indoor locations or similar areas in outdoor locations.
2. Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
3. Sumps and collection systems.
4. Other approved engineered systems. Except for surfacing, the floors, sills, dikes, sumps and collection systems shall be constructed of noncombustible material, and the liquid-tight seal shall be compatible with the material stored. When liquid-tight sills or dikes are provided, they are not required at perimeter

openings having an open-grate trench across the opening that connects to an approved collection system.

- 25.4.2.2 Secondary containment for hazardous material liquids and solids.** Where required by Table 25.4.2.2 buildings, rooms or areas used for the storage of hazardous materials liquids or solids shall be provided with secondary containment in accordance with this section when the capacity of an individual vessel or the aggregate capacity of multiple vessels exceeds the following:
- 1. Liquids:** Capacity of an individual vessel exceeds 208 L or the aggregate capacity of multiple vessels exceeds 3,785 L; and
  - 2. Solids:** Capacity of an individual vessel exceeds 250 kg or the aggregate capacity of multiple vessels exceeds 4,540 kg.
- 25.4.2.2.1 Drainage methods.** The building, room or area shall contain or drain the hazardous materials and fire protection water through the use of one of the following methods:
- 1.** Liquid-tight sloped or recessed floors in indoor locations or similar areas in outdoor locations.
  - 2.** Liquid-tight floors in indoor locations or similar areas in outdoor locations provided with liquid-tight raised or recessed sills or dikes.
  - 3.** Sumps and collection systems.
  - 4.** Drainage systems leading to an approved location.
  - 5.** Other approved engineered systems.
- 25.4.2.2.2 Incompatible materials.** Incompatible materials used in open systems shall be separated from each other in the secondary containment system.
- 25.4.2.2.3 Indoor design.** Secondary containment for indoor storage areas shall be designed to contain a spill from the largest vessel plus the design flow volume of fire protection water calculated to discharge from the fire-extinguishing system over the minimum required system design area or area of the room or area in which the storage is located, whichever is smaller. The containment capacity shall be designed to contain the flow for a period of 20 minutes.
- 25.4.2.2.4 Outdoor design.** Secondary containment for outdoor storage areas shall be designed to contain a spill from the largest individual vessel. If the area is open to rainfall, secondary containment shall be designed to include the volume of a 24 hours rainfall as determined by a 25 years storm and provisions shall be made to drain accumulations of ground water and rainwater.
- 25.4.2.2.5 Monitoring.** An approved monitoring method shall be provided to detect hazardous materials in the secondary containment system. The monitoring method is allowed to be visual inspection of the primary or secondary containment, or other approved means. Where secondary containment is subject to the intrusion of water, a monitoring method for detecting water shall be provided. Where monitoring devices are provided, they shall be connected to approve visual or audible alarms.
- 25.4.2.2.6 Drainage system design.** Drainage systems shall be in accordance with the SBC 701 and all of the following:
- 1.** The slope of floors to drains in indoor locations, or similar areas in outdoor locations shall not be less than 1 percent.
  - 2.** Drains from indoor storage areas shall be sized to carry the volume of the fire protection water as determined by the design density discharged from the automatic fire-extinguishing system over the minimum required system design area or area of the room or area in which the storage is located, whichever is smaller.
  - 3.** Drains from outdoor storage areas shall be sized to carry the volume of the fire flow and the volume of a 24 hours rainfall as determined by a 25 year storm.

4. Materials of construction for drainage systems shall be compatible with the materials stored.
5. Incompatible materials used in open systems shall be separated from each other in the drainage system.
6. Drains shall terminate in an approved location away from buildings, valves, means of egress, fire access roadways, adjoining property and storm drains.

**TABLE 25.4.2.2**  
**REQUIRED SECONDARY CONTAINMENT—HAZARDOUS MATERIAL SOLIDS AND LIQUIDS STORAGE**

MATERIAL		INDOOR USE		OUTDOOR USE	
		Solids	Liquids	Solids	Liquids
1. Physical-hazard materials					
Combustible liquids	Class II	Not Applicable	See Chapter 32	Not Applicable	See Chapter 32
	Class IIIA		See Chapter 32		See Chapter 32
	Class IIIB		See Chapter 32		See Chapter 32
Cryogenic fluids			See Chapter 30		See Chapter 32
Explosives		See Chapter 31		See Chapter 30	
Flammable liquids	Class IA	Not Applicable	See Chapter 32	Not Applicable	See Chapter 32
	Class IB		See Chapter 32		See Chapter 32
	Class IC		See Chapter 32		See Chapter 32
Flammable solids		Not Required	Not Applicable	Not Required	Not Applicable
Organic peroxides	Unclassified Detonable	Required	Required	Not Required	Not Required
	Class I				
	Class II				
	Class III				
	Class IV				
Class V	Not Required	Not Required	Not Required	Not Required	
Oxidizers	Class 4	Required	Required	Not Required	Not Required
	Class 3				
	Class 2	Not Required	Not Required	Not Required	Not Required
	Class 1				
Pyrophorics		Not Required	Required	Not Required	Required
Unstable (reactives)	Class 4	Required	Required	Required	Required
	Class 3				
	Class 2				
	Class 1	Not Required	Not Required	Not Required	Not Required
Water reactives	Class 3	Required	Required	Required	Required
	Class 2				
	Class 1	Not Required	Not Required	Not Required	Not Required
2. Health-hazard materials					
Corrosives		Not Required	Required	Not Required	Required
Highly toxics		Required	Required	Required	Required
Toxics					

- 25.4.2.3 Containment pallets.** When used as an alternative to spill control and secondary containment for outdoor storage in accordance with the exception in Section 25.4.2, containment pallets shall comply with all of the following:
1. A liquid-tight sump accessible for visual inspection shall be provided.
  2. The sump shall be designed to contain not less than 250 L.
  3. Exposed surfaces shall be compatible with material stored.
  4. Containment pallets shall be protected to prevent collection of rainwater within the sump.
- 25.4.3 Ventilation.** Indoor storage areas and storage buildings shall be provided with mechanical exhaust ventilation or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored.  
**Exception:** Storage areas for flammable solids complying with Chapter 34.
- 25.4.3.1 System requirements.** Exhaust ventilation systems shall comply with all of the following:
1. Installation shall be in accordance with the SBC 501.
  2. Mechanical ventilation shall be at a rate of not less than  $0.00508 \text{ m}^3/(\text{s}\cdot\text{m}^2)$  of floor area over the storage area.
  3. Systems shall operate continuously unless alternative designs are approved.
  4. A manual shutoff control shall be provided outside of the room in a position adjacent to the access door to the room or in an approved location. The switch shall be of the break-glass type and shall be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.
  5. Exhaust ventilation shall be designed to consider the density of the potential fumes or vapors released. For fumes or vapors that are heavier than air, exhaust shall be taken from a point within 305 mm of the floor.
  6. The location of both the exhaust and inlet air openings shall be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.
  7. Exhaust ventilation shall not be recirculated within the room or building if the materials stored are capable of emitting hazardous vapors.
- 25.4.4 Separation of incompatible hazardous materials.** Incompatible materials shall be separated in accordance with Section 25.3.9.8.
- 25.4.5 Automatic sprinkler systems.** Indoor storage areas and storage buildings shall be equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. The design of the sprinkler system shall not be less than that required for Ordinary Hazard Group 2 with a minimum design area of  $279 \text{ m}^2$ . Where the materials or storage arrangement are required by other regulations to be provided with a higher level of sprinkler system protection, the higher level of sprinkler system protection shall be provided.
- 25.4.6 Explosion control.** Indoor storage rooms, areas and buildings shall be provided with explosion control in accordance with Section 7.11.
- 25.4.7 Standby or emergency power.** Where mechanical ventilation, treatment systems, temperature control, alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with the SBC 401 and Section 5D.4.

**Exceptions:**

1. Storage areas for Class 1 and 2 oxidizers.
2. Storage areas for Class III, IV and V organic peroxides.
3. For storage areas for highly toxic or toxic materials, see Sections 35.4.2.2.8 and 35.4.3.2.6.
4. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an approved fail-safe engineered system is installed.

**25.4.8 Limit controls.** Limit controls shall be provided in accordance with Sections 25.4.8.1 and 25.4.8.2.

**25.4.8.1 Temperature control.** Materials that must be kept at temperatures other than normal ambient temperatures to prevent a hazardous reaction shall be provided with an approved means to maintain the temperature within a safe range. Redundant temperature control equipment that will operate on failure of the primary temperature control system shall be provided. Where approved, alternative means that prevent a hazardous reaction are allowed.

**25.4.8.2 Pressure control.** Stationary tanks and equipment containing hazardous material liquids that can generate pressures exceeding design limits because of exposure fires or internal reaction, shall have some form of construction or other approved means that will relieve excessive internal pressure. The means of pressure relief shall vent to an approved location or to an exhaust scrubber or treatment system where required by Chapter 35.

**25.4.9 Emergency alarm.** An approved manual emergency alarm system shall be provided in buildings, rooms or areas used for storage of hazardous materials. Emergency alarm-initiating devices shall be installed outside of each interior exit or exit access door of storage buildings, rooms or areas. Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants of an emergency situation involving hazardous materials.

**25.4.10 Supervision.** Emergency alarm, detection and automatic fire-extinguishing systems required by Section 25.4 shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.

**25.4.11 Clearance from combustibles.** The area surrounding an outdoor storage area or tank shall be kept clear of combustible materials and vegetation for a minimum distance of 7.6 m.

**25.4.12 Noncombustible floor.** Except for surfacing, floors of storage areas shall be of noncombustible construction.

**25.4.13 Weather protection.** Where overhead noncombustible construction is provided for sheltering outdoor hazardous material storage areas, such storage shall not be considered indoor storage when the area is constructed in accordance with the requirements for weather protection as required by the SBC 100.

**Exception:** Storage of explosive materials shall be considered as indoor storage.

## SECTION 25.5 USE, DISPENSING AND HANDLING

**25.5.1 General.** Use, dispensing and handling of hazardous materials in amounts

exceeding the maximum allowable quantity per control area set forth in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3 and 25.5. Use, dispensing and handling of hazardous materials in amounts not exceeding the maximum allowable quantity per control area set forth in Section 25.3.1 shall be in accordance with Sections 25.1 and 25.3.

- 25.5.1.1 Separation of incompatible materials.** Separation of incompatible materials shall be in accordance with Section 25.3.9.8.
- 25.5.1.2 Noncombustible floor.** Except for surfacing, floors of areas where liquid or solid hazardous materials are dispensed or used in open systems shall be of noncombustible, liquid-tight construction.
- 25.5.1.3 Spill control and secondary containment for hazardous material liquids.** Where required by other provisions of Section 25.5, spill control and secondary containment shall be provided for hazardous material liquids in accordance with Section 25.4.2.
- 25.5.1.4 Limit controls.** Limit controls shall be provided in accordance with Sections 25.5.1.4.1 through 25.5.1.4.4.
  - 25.5.1.4.1 High-liquid-level control.** Open tanks in which liquid hazardous materials are used shall be equipped with a liquid-level limit control or other means to prevent overfilling of the tank.
  - 25.5.1.4.2 Low-liquid-level control.** Approved safeguards shall be provided to prevent a low-liquid level in a tank from creating a hazardous condition, including but not limited to, overheating of a tank or its contents.
  - 25.5.1.4.3 Temperature control.** Temperature control shall be provided in accordance with Section 25.4.8.1.
  - 25.5.1.4.4 Pressure control.** Pressure control shall be provided in accordance with Section 25.4.8.2.
- 25.5.1.5 Standby or emergency power.** Where mechanical ventilation, treatment systems, temperature control, manual alarm, detection or other electrically operated systems are required, such systems shall be provided with an emergency or standby power system in accordance with the SBC 401 and Section 5D.4.

**Exceptions:**

- 1. Standby power for mechanical ventilation, treatment systems and temperature control systems shall not be required where an approved fail-safe engineered system is installed.
- 2. Systems for highly toxic or toxic gases shall be provided with emergency power in accordance with Sections 35.4.2.2.8 and 35.4.3.2.6.
- 25.5.1.6 Supervision.** Manual alarm, detection and automatic fire-extinguishing systems required by other provisions of Section 25.5 shall be supervised by an approved central, proprietary or remote station service or shall initiate an audible and visual signal at a constantly attended on-site location.
- 25.5.1.7 Lighting.** Adequate lighting by natural or artificial means shall be provided.
- 25.5.1.8 Fire-extinguishing systems.** Indoor rooms or areas in which hazardous materials are dispensed or used shall be protected by an automatic fire-extinguishing system in accordance with Chapter 7. Sprinkler system design shall not be less than that required for Ordinary Hazard, Group 2, with a minimum design area of 279 m<sup>2</sup>. Where the materials or storage arrangement are required by other regulations to be provided with a higher level of sprinkler system protection, the higher level of sprinkler system protection shall be provided.
- 25.5.1.9 Ventilation.** Indoor dispensing and use areas shall be provided with exhaust ventilation in accordance with Section 25.4.3.
 

**Exception:** Ventilation is not required for dispensing and use of flammable solids other than finely divided particles.



- 25.5.1.10 Liquid transfer.** Liquids having a hazard ranking of 3 or 4 in accordance with NFPA 704 shall be transferred by one of the following methods:
1. From safety cans complying with UL 30.
  2. Through an approved closed piping system.
  3. From containers or tanks by an approved pump taking suction through an opening in the top of the container or tank.
  4. From containers or tanks by gravity through an approved self-closing or automatic-closing valve when the container or tank and dispensing operations are provided with spill control and secondary containment in accordance with Section 25.4.2. Highly toxic liquids shall not be dispensed by gravity from tanks.
  5. Approved engineered liquid transfer systems.
- Exceptions:**
1. Liquids having a hazard ranking of 4 when dispensed from approved containers not exceeding 5 L.
  2. Liquids having a hazard ranking of 3 when dispensed from approved containers not exceeding 20 L.
- 25.5.2 Indoor dispensing and use.** Indoor dispensing and use of hazardous materials shall be in buildings complying with the SBC 201 and in accordance with Section 25.5.1 and Sections 25.5.2.1 through 25.5.2.2.5.
- 25.5.2.1 Open systems.** Dispensing and use of hazardous materials in open containers or systems shall be in accordance with Sections 25.5.2.1.1 through 25.5.2.1.4.
- 25.5.2.1.1 Ventilation.** Where gases, liquids or solids having a hazard ranking of 3 or 4 in accordance with NFPA 704 are dispensed or used, mechanical exhaust ventilation shall be provided to capture fumes, mists or vapors at the point of generation.  
**Exception:** Gases, liquids or solids which can be demonstrated not to create harmful fumes, mists or vapors.
- 25.5.2.1.2 Explosion control.** Explosion control shall be provided in accordance with Section 25.4.6 when an explosive environment can occur because of the characteristics or nature of the hazardous materials dispensed or used, or as a result of the dispensing or use process.
- 25.5.2.1.3 Spill control for hazardous material liquids.** Buildings, rooms or areas where hazardous material liquids are dispensed into vessels exceeding a 5 L capacity or used in open systems exceeding a 20 L capacity shall be provided with spill control in accordance with Section 25.4.2.1.
- 25.5.2.1.4 Secondary containment for hazardous material liquids.** Where required by Table 25.5.2.1.4, buildings, rooms or areas where hazardous material liquids are dispensed or used in open systems shall be provided with secondary containment in accordance with Section 25.4.2.2 when the capacity of an individual vessel or system or the capacity of multiple vessels or systems exceeds the following:
1. Individual vessel or system: greater than 5 L.
  2. Multiple vessels or systems: greater than 20 L.
- 25.5.2.2 Closed systems.** Use of hazardous materials in closed containers or systems shall be in accordance with Sections 25.5.2.2.1 through 25.5.2.2.5.
- 25.5.2.2.1 Design.** Systems shall be suitable for the use intended and shall be designed by persons competent in such design. Controls shall be designed to prevent materials from entering or leaving the process or reaction systems at other than the intended time, rate or path. Where automatic controls are provided, they shall be designed to be fail safe.
- 25.5.2.2.2 Ventilation.** Where closed systems are designed to be opened as part of normal operations, ventilation shall be provided in accordance with Section 25.5.2.1.1.

**TABLE 25.5.2.1.4  
REQUIRED SECONDARY CONTAINMENT—HAZARDOUS MATERIAL SOLIDS AND LIQUIDS USE**

MATERIAL		INDOOR USE		OUTDOOR USE	
		Solids	Liquids	Solids	Liquids
1. Physical-hazard materials					
Combustible liquids	Class II	Not Applicable	See Chapter 32	Not Applicable	See Chapter 32
	Class IIIA		See Chapter 32		See Chapter 32
	Class IIIB		See Chapter 32		See Chapter 32
Cryogenic fluids		Not Applicable	See Chapter 30	Not Applicable	See Chapter 30
Explosives		See Chapter 31		See Chapter 31	
Flammable liquids	Class IA	Not Applicable	See Chapter 32	Not Applicable	See Chapter 32
	Class IB		See Chapter 32		See Chapter 32
	Class IC		See Chapter 32		See Chapter 32
Flammable solids		Not Required	Not Applicable	Not Required	Not Applicable
Organic peroxides	Unclassified Detonable	Not Required	Required	Not Required	Required
	Class I		Required	Not Required	Required
	Class II				
	Class III		Not Required	Not Required	Not Required
	Class IV				
Class V	Not Required		Not Required	Not Required	
Oxidizers	Class 4	Required	Required	Not Required	Required
	Class 3				
	Class 2				
	Class 1				
Pyrophorics		Not Required	Required	Not Required	Required
Unstable (reactives)	Class 4	Not Required	Required	Required	Required
	Class 3				
	Class 2	Not Required	Not Required	Required	Required
Water reactives	Class 3	Not Required	Required	Required	Required
	Class 2				
	Class 1	Not Required	Not Required	Required	Required
2. Health-hazard materials					
Corrosives		Not Required	Required	Not Required	Required
Highly toxics		Required			
Toxics		Not Required			

**25.5.2.2.3 Explosion control.** Explosion control shall be provided in accordance with Section 25.4.6 where an explosive environment exists because of the hazardous materials dispensed or used, or as a result of the dispensing or use process.

**Exception:** Where process vessels are designed to contain fully the worst-case explosion anticipated within the vessel under process conditions based on the most likely failure.

- 25.5.2.2.4 Spill control for hazardous material liquids.** Buildings, rooms or areas where hazardous material liquids are used in individual vessels exceeding a 208 L capacity shall be provided with spill control in accordance with Section 25.4.2.1.
- 25.5.2.2.5 Secondary containment for hazardous material liquids.** Where required by Table 25.5.2.1.4, buildings, rooms or areas where hazardous material liquids are used in vessels or systems shall be provided with secondary containment in accordance with Section 25.4.2.2 when the capacity of an individual vessel or system or the capacity of multiple vessels or systems exceeds the following:
1. Individual vessel or system: greater than 208 L.
  2. Multiple vessels or systems: greater than 3,785 L.
- 25.5.3 Outdoor dispensing and use.** Dispensing and use of hazardous materials outdoors shall be in accordance with Sections 25.5.3.1 through 25.5.3.9.
- 25.5.3.1 Quantities exceeding the maximum allowable quantity per control area.** Outdoor dispensing or use of hazardous materials, in either closed or open containers or systems, in amounts exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(3) and 25.3.1.1(4) shall be in accordance with Sections 25.1, 25.3, 25.5.1 and 25.5.3.
- 25.5.3.2 Quantities not exceeding the maximum allowable quantity per control area.** Outdoor dispensing or use of hazardous materials, in either closed or open containers or systems, in amounts not exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(3) and 25.3.1.1(4) shall be in accordance with Sections 25.1 and 25.3.
- 25.5.3.3 Location.** Outdoor dispensing and use areas for hazardous materials shall be located as required for outdoor storage in accordance with Section 25.4.
- 25.5.3.4 Spill control for hazardous material liquids in open systems.** Outdoor areas where hazardous material liquids are dispensed in vessels exceeding a 5 L capacity or used in open systems exceeding a 20 L capacity shall be provided with spill control in accordance with Section 25.4.2.1.
- 25.5.3.5 Secondary containment for hazardous material liquids in open systems.** Where required by Table 25.5.2.1.4, outdoor areas where hazardous material liquids are dispensed or used in open systems shall be provided with secondary containment in accordance with Section 25.4.2.2 when the capacity of an individual vessel or system or the capacity of multiple vessels or systems exceeds the following:
1. Individual vessel or system: greater than 5 L.
  2. Multiple vessels or systems: greater than 520 L.
- 25.5.3.6 Spill control for hazardous material liquids in closed systems.** Outdoor areas where hazardous material liquids are used in closed systems exceeding 208 L shall be provided with spill control in accordance with Section 25.4.2.1.
- 25.5.3.7 Secondary containment for hazardous material liquids in closed systems.** Where required by Table 25.5.2.1.4, outdoor areas where hazardous material liquids are dispensed or used in closed systems shall be provided with secondary containment in accordance with Section 25.4.2.2 when the capacity of an individual vessel or system or the capacity of multiple vessels or systems exceeds the following:
1. Individual vessel or system: greater than 208 L.
  2. Multiple vessels or systems: greater than 3,785 L.
- 25.5.3.8 Clearance from combustibles.** The area surrounding an outdoor dispensing or use area shall be kept clear of combustible materials and vegetation for a minimum distance of 9.1 m.

- 25.5.3.9 Weather protection.** Where overhead noncombustible construction is provided for sheltering outdoor hazardous material use areas, such use shall not be considered indoor use when the area is constructed in accordance with the requirements for weather protection as required in the SBC 201.  
**Exception:** Use of explosive materials shall be considered as indoor use.
- 25.5.4 Handling.** Handling of hazardous materials shall be in accordance with Sections 25.5.4.1 through 25.5.4.4.
- 25.5.4.1 Quantities exceeding the maximum allowable quantity per control area.** Handling of hazardous materials in indoor and outdoor locations in amounts exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(1) through 25.3.1.1(4) shall be in accordance with Sections 25.1, 25.3, 25.5.1 and 25.5.4.
- 25.5.4.2 Quantities not exceeding the maximum allowable quantity per control area.** Handling of hazardous materials in indoor locations in amounts not exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(1) and 25.3.1.1(2) shall be in accordance with Sections 25.1, 25.3 and 25.5.1. Handling of hazardous materials in outdoor locations in amounts not exceeding the maximum allowable quantity per control area indicated in Tables 25.3.1.1(3) and 25.3.1.1(4) shall be in accordance with Sections 25.1 and 25.3.
- 25.5.4.3 Location.** Outdoor handling areas for hazardous materials shall be located as required for outdoor storage in accordance with Section 25.4.
- 25.5.4.4 Emergency alarm.** Where hazardous materials having a hazard ranking of 3 or 4 in accordance with NFPA 704 are transported through corridors or exit enclosures, there shall be an emergency telephone system, a local manual alarm station or an approved alarm-initiating device at not more than 46 m intervals and at each exit and exit access doorway throughout the transport route. The signal shall be relayed to an approved central station, proprietary supervising station or remote supervising station or a constantly attended on-site location and shall also initiate a local audible alarm.

## CHAPTER 26 AEROSOLS

### SECTION 26.1 GENERAL

- 26.1.1 Scope.** The provisions of this chapter, the SBC and NFPA 30B shall apply to the manufacturing, storage and display of aerosol products in addition to the requirements of Chapter 25.
- 26.1.2 Permit required.** Permits shall be required as set forth in SBC 100.
- 26.1.3 Material Safety Data Sheets.** Material Safety Data Sheet (MSDS) information for aerosol products displayed shall be kept on the premises at an approved location.

### SECTION 26.2 DEFINITIONS

- 26.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**AEROSOL.** A product that is dispensed from an aerosol container by a propellant. Aerosol products shall be classified by means of the calculation of their chemical heats of combustion and shall be designated Level 1, Level 2 or Level 3.

**Level 1 aerosol products.** Those with a total chemical heat of combustion that is less than or equal to 20 kJ/g.

**Level 2 aerosol products.** Those with a total chemical heat of combustion that is greater than 20 kJ/g, but less than or equal to 30 kJ/g.

**Level 3 aerosol products.** Those with a total chemical heat of combustion that is greater than 30 kJ/g.

**AEROSOL CONTAINER.** A metal can, or a glass or plastic bottle designed to dispense an aerosol. Metal cans shall be limited to a maximum size of 1,000 ml. Glass or plastic bottles shall be limited to a maximum size of 118 ml.

**AEROSOL WAREHOUSE.** A building used for warehousing aerosol products.

**PROPELLANT.** The liquefied or compressed gas in an aerosol container that expels the contents from an aerosol container when the valve is actuated. A propellant is considered flammable if it forms a flammable mixture with air, or if a flame is self-propagating in a mixture with air.

**RETAIL DISPLAY AREA.** The area of a Group M occupancy open for the purpose of viewing or purchasing merchandise offered for sale. Individuals in such establishments are free to circulate among the items offered for sale which are typically displayed on shelves, racks or the floor.

### SECTION 26.3 CLASSIFICATION OF AEROSOL PRODUCTS

- 26.3.1 Classification levels.** Aerosol products shall be classified as Level 1, 2 or 3 in accordance with Table 26.3.1 and NFPA 30B. Aerosol products in cartons which are not identified in accordance with this section shall be classified as Level 3.

**TABLE 26.3.1  
CLASSIFICATION OF AEROSOL PRODUCTS**

CHEMICAL HEAT OF COMBUSTION		AEROSOL CLASSIFICATION
Greater than (kJ/g)	Less than or equal to (kJ/g)	
0	20	1
20	30	2
30	—	3

- 26.3.2 Identification.** Cartons shall be identified on at least one side with the classification level of the aerosol products contained within the carton as follows:

LEVEL \_\_\_\_\_ AEROSOLS

### SECTION 26.4 INSIDE STORAGE OF AEROSOL PRODUCTS

- 26.4.1 General.** The inside storage of Level 2 and 3 aerosol products shall comply with Sections 26.4.2 through 26.4.7 and NFPA 30B. Level I aerosol products shall be considered equivalent to a Class III commodity and shall comply with the requirements for palletized or rack storage in NFPA 13.
- 26.4.2 Storage in Groups A, B, E, F, I and R.** Storage of Level 2 and 3 aerosol products in occupancies in Groups A, B, E, F, I and R shall be limited to the following maximum quantities:
1. A net weight of 454 kg of Level 2 aerosol products.
  2. A net weight of 227 kg of Level 3 aerosol products.
  3. A combined net weight of 454 kg of Level 2 and 3 aerosol products.
- The maximum quantity shall be increased 100 percent where the excess quantity is stored in storage cabinets in accordance with Section 32.4.3.2.
- 26.4.2.1 Excess storage.** Storage of quantities exceeding the maximum quantities indicated in Section 26.4.2 shall be stored in separate inside flammable liquid storage rooms in accordance with Section 26.4.5.
- 26.4.3 Storage in general purpose warehouses.** Aerosol storage in general purpose warehouses utilized only for warehousing-type operations involving mixed commodities shall comply with Section 26.4.3.1 or 26.4.3.2.
- 26.4.3.1 Nonsegregated storage.** Storage consisting of solid pile, palletized or rack storage of Level 2 and 3 aerosol products not segregated into areas utilized exclusively for the storage of aerosols shall comply with Table 26.4.3.1.
- 26.4.3.2 Segregated storage.** Storage of Level 2 and 3 aerosol products segregated into areas utilized exclusively for the storage of aerosols shall comply with Table 26.4.3.2 and Sections 26.4.3.2.1 and 26.4.3.2.2.

**TABLE 26.4.3.1**  
**NONSEGREGATED STORAGE OF LEVEL 2 AND 3 AEROSOL PRODUCTS IN**  
**GENERAL PURPOSE WAREHOUSES**

AEROSOL LEVEL	MAXIMUM NET WEIGHT PER FLOOR (kilograms) <sup>b</sup>			
	Palletized or Solid-pile storage		Rack storage	
	Unprotected	Protected <sup>a</sup>	Unprotected	Protected <sup>a</sup>
2	1,135	5,448	1,135	10,896
3	454	5,448	454	10,896
Combination 2 and 3	1,135	5,448	1,135	10,896

- Approved automatic sprinkler system protection and storage arrangements shall comply with NFPA 30B. Sprinkler system protection shall extend 6.1 m beyond the storage area containing the aerosol products.
- Storage quantities indicated are the maximum permitted in any 4,645-square-meter area.

**TABLE 26.4.3.2**  
**SEGREGATED STORAGE OF LEVEL 2 AND 3 AEROSOL PRODUCTS IN GENERAL**  
**PURPOSE WAREHOUSES**

STORAGE SEPARATION	MAXIMUM SEGREGATED STORAGE AREA <sup>a</sup>		SPRINKLER REQUIREMENTS
	Percentage of building area (percent)	Area limitation (square meter)	
Separation area <sup>c,f</sup>	15	1,858	Notes b, c
Chain-link fence enclosure <sup>d</sup>	20	1,858	Notes b, c
1-hour fire-resistance-rated interior walls	20	2,787	Note b
2-hour fire-resistance-rated interior walls	25	3,716	Note b
3-hour fire-resistance-rated interior walls	30	4,645	Note b

- The maximum segregated storage area shall be limited to the smaller of the two areas resulting from the percentage of building area limitation and the area limitation.
- Automatic sprinkler system protection in aerosol product storage areas shall comply with NFPA 30B and be approved. Building areas not containing aerosol product storage shall be equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1.
- Automatic sprinkler system protection in aerosol product storage areas shall comply with NFPA 30B and be approved. Sprinkler system protection shall extend a minimum 6.1 m beyond the aerosol storage area.
- Chain-link fence enclosures shall comply with Section 26.4.3.2.1.
- A separation area shall be defined as an area extending outward from the periphery of the segregated aerosol product storage area as follows:
  - The limits of the aerosol product storage shall be clearly marked on the floor.
  - The separation distance shall be a minimum of 7.6 m and maintained clear of all materials with a commodity classification greater than Class III in accordance with Section 7.3.3.1.1.
- Separation areas shall only be permitted where approved.

**26.4.3.2.1 Chain-link fence enclosures.** Chain-link fence enclosures required by Table 26.4.3.2 shall comply with the following:

- The fence shall not be less than No. 9 gage steel wire, woven into a maximum 51 mm diamond mesh.
- The fence shall be installed from the floor to the underside of the roof or ceiling above.

3. Class III, IV and high-hazard commodities shall be stored outside of the aerosol storage area and a minimum of 2.4 m from the fence.
4. Access openings in the fence shall be provided with either self-closing or automatic-closing devices or a labyrinth opening arrangement preventing aerosol containers from rocketing through the access openings.
5. Not less than two means of egress shall be provided from the fenced enclosure.

**26.4.3.2.2 Aisles.** The minimum aisle requirements for segregated storage in general purpose warehouses shall comply with Table 26.4.3.2.2.

**TABLE 26.4.3.2.2  
SEGREGATED STORAGE AISLE WIDTHS AND DISTANCE TO AISLES IN  
GENERAL PURPOSE WAREHOUSES**

STORAGE CONDITION	MINIMUM AISLE WIDTH (m)	MAXIMUM FROM STORAGE TO AISLE (m)
Solid pile or palletized <sup>a</sup>	1.2 m between piles	7.6
Racks with ESFR sprinklers <sup>a</sup>	1.2 m between racks and adjacent level 2 and 3 aerosol product storage	7.6
Racks with ESFR sprinklers <sup>a</sup>	2.4 m between racks and adjacent level 2 and 3 aerosol product storage	7.6

a. Sprinklers shall comply with NFPA 30B.

**26.4.4 Storage in aerosol warehouses.** The total quantity of Level 2 and 3 aerosol products in a warehouse utilized for the storage, shipping and receiving of aerosol products shall not be restricted in structures complying with Sections 26.4.4.1 through 26.4.4.4.

**26.4.4.1 Automatic sprinkler system.** Aerosol warehouses shall be protected by an approved wet-pipe automatic sprinkler system in accordance with NFPA 30B. Sprinkler protection shall be designed based on the highest classification level of aerosol product present.

**26.4.4.2 Pile and palletized storage aisles.** Solid pile and palletized storage shall be arranged so the maximum travel distance to an aisle is 7.6 m. Aisles shall have a minimum width of 1.2 m.

**26.4.4.3 Rack storage aisles.** Rack storage shall be arranged with a minimum aisle width of 2.4 m between rows of racks and 2.4 m between racks and adjacent solid pile or palletized storage. Where early suppression fast-response (ESFR) sprinklers provide automatic sprinkler protection, the minimum aisle width shall be 1.2 m.

**26.4.4.4 Combustible commodities.** Combustible commodities other than flammable and combustible liquids shall be permitted to be stored in an aerosol warehouse.

**Exception:** Flammable and combustible liquids in 0.95 L metal containers and smaller shall be permitted to be stored in an aerosol warehouse.

**26.4.5 Storage in inside flammable liquid storage rooms.** Inside flammable liquid storage rooms shall comply with Section 32.4.3.7. The maximum quantities of aerosol products shall comply with Section 26.4.5.1 or 26.4.5.2.

**26.4.5.1 Storage rooms of 46 square meter or less.** The storage of aerosol products in flammable liquid storage rooms less than or equal to 46 m<sup>2</sup> in area shall not exceed the following quantities:



1. A net weight of 454 kg of Level 2 aerosol products.
2. A net weight of 227 kg of Level 3 aerosol products.
3. A combined net weight of 454 kg of Level 2 and 3 aerosol products.

**26.4.5.2 Storage rooms greater than 46 square meters.** The storage of aerosol products in flammable liquid storage rooms greater than 46 m<sup>2</sup> in area shall not exceed the following quantities:

1. A net weight of 1,135 kg of Level 2 aerosol products.
2. A net weight of 454 kg of Level 3 aerosol products.
3. A combined net weight of 1,135 kg of Level 2 and 3 aerosol products.

The maximum aggregate storage quantity of Level 2 and 3 aerosol products permitted in separate inside storage rooms protected by an approved automatic sprinkler system in accordance with NFPA 30B shall be 2,270 kg.

**26.4.6 Storage in liquid warehouses.** The storage of Level 2 and 3 aerosol products in liquid warehouses shall comply with NFPA 30B. The storage shall be located within segregated storage areas in accordance with Section 26.4.3.2 and Sections 26.4.6.1 through 26.4.6.3.

**26.4.6.1 Containment.** Spill control or drainage shall be provided to prevent the flow of liquid to within 2.4 m of the segregated storage area.

**26.4.6.2 Sprinkler design.** Sprinkler protection shall be designed based on the highest level of aerosol product present.

**26.4.6.3 Opening protection into segregated storage areas.** Fire doors or gates opening into the segregated storage area shall either be self-closing or provided with automatic-closing devices activated by sprinkler water flow or an approved fire detection system.

**26.4.7 Storage in Group M occupancies.** Storage of Level 2 and 3 aerosol products in occupancies in Group M shall comply with Table 26.4.7. Retail display shall comply with Section 26.6.

**TABLE 26.4.7  
MAXIMUM QUANTITIES OF LEVEL 2 AND 3 AEROSOL  
PRODUCTS IN RETAIL STORAGE AREAS**

<b>MAXIMUM NET WEIGHT PER FLOOR (kilograms)</b>			
<b>Floor</b>	<b>Nonsegregated storage<sup>a,b</sup></b>	<b>Segregated storage</b>	
		<b>Storage cabinets<sup>b</sup></b>	<b>Separated from retail area<sup>c</sup></b>
Basement	Not permitted	Not permitted	Not permitted
Ground floor	1,135	2,270	Note d
Upper floor	227	454	Note d

- a. The total aggregate quantity on display and in storage shall not exceed the maximum retail display quantity indicated in Section 26.6.3.
- b. Storage quantities indicated are the maximum permitted in any 4,645 m<sup>2</sup> area.
- c. The storage area shall be separated from the retail area with a 1-hour fire-resistance-rated assembly.
- d. See Table 26.4.3.2.

## SECTION 26.5 OUTSIDE STORAGE

- 26.5.1 General.** The outside storage of Level 2 and 3 aerosol products, including storage in temporary storage trailers, shall be separated from exposures in accordance with Table 26.5.1.

**TABLE 26.5.1  
DISTANCE TO EXPOSURES FOR OUTSIDE STORAGE OF LEVEL 2  
AND 3 AEROSOL PRODUCTS**

EXPOSURE	MINIMUM DISTANCE FROM AEROSOL STORAGE (m) <sup>a</sup>
Public alleys, public ways, public streets	6.1
Buildings	15.3
Exit discharge to a public way	15.3
Lot lines	6.1
Other outside storage	15.3

- a. The minimum separation distance indicated is not required where exterior walls having a 2 hour fire-resistance rating without penetrations separate the storage from the exposure. The walls shall extend not less than 762 mm above and to the sides of Level 2 and 3 aerosol products.

## SECTION 26.6 RETAIL DISPLAY

- 26.6.1 General.** This section shall apply to the retail display of 227 kg or more of Level 2 and 3 aerosol products.
- 26.6.2 Maximum quantities in retail display areas.** Aerosol products in retail display areas shall not exceed quantities needed for display and normal merchandising and shall not exceed the quantities in Table 26.6.2.
- 26.6.3 Maximum quantities in storage areas.** Aerosol products in storage areas adjacent to retail display areas shall not exceed the quantities in Table 26.6.3.
- 26.6.4 Display of containers.** Level 2 and 3 aerosol containers shall not be stacked more than 1.8 m high from the base of the aerosol array to the top of the aerosol array unless the containers are placed on fixed shelving or otherwise secured in an approved manner. When storage or retail display is on shelves, the height of such storage or retail display to the top of aerosol containers shall not exceed 2.4 m.  
**Exception:** Storage or display protected in accordance with Sections 26.6.2 and 26.6.3.

**TABLE 26.6.2**  
**MAXIMUM QUANTITIES OF LEVEL 2 AND 3 AEROSOL PRODUCTS**  
**IN RETAIL DISPLAY AREAS**

<b>FLOOR</b>	<b>MAXIMUM NET WEIGHT PER FLOOR (kilograms)<sup>a,b</sup></b>	
	<b>Unprotected<sup>c</sup></b>	<b>Protected<sup>c,d</sup></b>
Basement	Not allowed	227
Ground	1,135	4,540
Upper	227	908

- The total quantity shall not exceed 454 kg net weight in any one 9-square-meter retail display area.
- When packaged, stored and protected in accordance with NFPA 30B, quantity limits shall be limited to those specified in NFPA 30B.
- Per 2,323-square-meter retail display area.
- Minimum Ordinary Hazard Group 2 wet-pipe automatic sprinkler system through the retail sales occupancy.

**TABLE 26.6.3**  
**MAXIMUM STORAGE QUANTITIES FOR STORAGE AREAS ADJACENT TO**  
**RETAIL DISPLAY OF LEVEL 2 AND LEVEL 3 AEROSOLS**

<b>MAXIMUM NET WEIGHT PER FLOOR (kilograms)</b>			
<b>Floor</b>	<b>Unseparated<sup>a,b</sup></b>	<b>Separated</b>	
		<b>Storage cabinets<sup>b</sup></b>	<b>1 hour occupancy separation</b>
Basement	Not allowed	Not allowed	Not allowed
Ground	1,135	2,270	In accordance with NFPA 30B, Sections 4-3.4.2 and 4-3.4.3
Upper	9	454	In accordance with NFPA 30B, Sections 4-3.4.2 and 4-3.4.3

- The aggregate quantity in storage and retail display shall not exceed the quantity limits for retail display.
- In any 4,645-square-meter area.

**26.6.5 Combustible cartons.** Aerosol products located in retail display areas shall be removed from combustible cartons.

**Exceptions:**

- Display areas that use a portion of combustible cartons, which consist of only the bottom panel and not more than 51 mm of side panel is allowed.
- When the display area is protected in accordance with Table 4-3 of NFPA 30B, storage of aerosol products in combustible cartons is allowed.

**26.6.6 Aisles.** Aisles not less than 1.2 m in width shall be maintained on three sides of a retail display area containing aerosol products.

- 26.6.7 Retail display automatic sprinkler system.** When an automatic sprinkler system is required for the protected retail display of aerosol products, the wet-pipe automatic sprinkler system shall be in accordance with Section 7.3.3.1.1. The minimum system design shall be for an Ordinary Hazard Group 2 occupancy. The system shall be provided throughout the retail display area.
- 26.6.8 Storage automatic fire-extinguishing system.** When the height of storage or display exceeds the limits in Section 26.6.4, the design of the automatic sprinkler system shall be in accordance with NFPA 30B.

## **SECTION 26.7 MANUFACTURING FACILITIES**

- 26.7.1 General.** Manufacturing facilities shall be in accordance with NFPA 30B.

## CHAPTER 27 COMBUSTIBLE FIBERS

### SECTION 27.1 GENERAL

- 27.1.1 Scope.** The equipment, processes and operations involving combustible fibers shall comply with this chapter.
- 27.1.2 Applicability.** Storage of combustible fibers in any quantity shall comply with this section.
- 27.1.3 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 27.2 DEFINITIONS

- 27.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in the SBC have the meaning shown herein.

**COMBUSTIBLE FIBERS.** Readily ignitable and free-burning fibers, such as cocoa fiber, cloth, cotton, excelsior, hay, hemp, henequen, istle, jute, kapok, oakum, rags, sisal, Spanish moss, straw, tow, wastepaper, certain synthetic fibers or other like materials.

### SECTION 27.3 GENERAL PRECAUTIONS

- 27.3.1 Use of combustible receptacles.** Ashes, waste, rubbish or sweepings shall not be placed in wood or other combustible receptacles and shall be removed daily from the structure.
- 27.3.2 Vegetation.** Grass or weeds shall not be allowed to accumulate at any point on the premises.
- 27.3.3 Clearances.** A minimum clearance of 900 mm shall be maintained between automatic sprinklers and the top of piles.
- 27.3.4 Agricultural products.** Hay, straw or similar agricultural products shall not be stored adjacent to structures or combustible materials unless a clear horizontal distance equal to the height of a pile is maintained between such storage and structures or combustible materials. Storage shall be limited to stacks of 91 tons each. Stacks shall be separated by a minimum of 6.1 m of clear space. Quantities of hay, straw and other agricultural products shall not be limited where stored in or near farm structures located outside closely built areas. A permit shall not be required for agricultural storage.
- 27.3.5 Dust collection.** Where located within a building, equipment or machinery which generates or emits combustible fibers shall be provided with an approved dust-collecting and exhaust system. Such systems shall comply with SBC 501.
- 27.3.6 Portable fire extinguishers.** Portable fire extinguishers shall be provided in accordance with Section 7.6 as required for extra-hazard occupancy protection as indicated in Table 7.6.3(1).

## SECTION 27.4 LOOSE FIBER STORAGE

- 27.4.1 General.** Loose combustible fibers, not in suitable bales or packages and whether housed or in the open, shall not be stored within 30.5 m of any structure, except as indicated in this chapter.
- 27.4.2 Storage of 3 m<sup>3</sup> or less.** Loose combustible fibers in quantities of not more than 3 m<sup>3</sup> located in a structure shall be stored in a metal or metal-lined bin equipped with a self-closing cover.
- 27.4.3 Storage of more than 3 m<sup>3</sup> to 14 m<sup>3</sup>.** Loose combustible fibers in quantities exceeding 3 m<sup>3</sup> but not exceeding 14 m<sup>3</sup> shall be stored in rooms enclosed with 1 hour fire-resistance-rated fire barriers, with openings protected by an approved opening protective assembly having a fire protection rating of  $\frac{3}{4}$  hour, constructed in accordance with the SBC.
- 27.4.4 Storage of more than 14 m<sup>3</sup> to 28 m<sup>3</sup>.** Loose combustible fibers in quantities exceeding 14 m<sup>3</sup> but not exceeding 28 m<sup>3</sup> shall be stored in rooms enclosed with 2 hours fire-resistance-rated fire barriers, with openings protected by an approved opening protective assembly having a fire protection rating of 1½ hours, and constructed in accordance with the SBC.
- 27.4.5 Storage of more than 28 m<sup>3</sup>.** Loose combustible fibers in quantities exceeding 28 m<sup>3</sup> shall be stored in rooms enclosed with 2 hours fire-resistance-rated fire barriers, with openings protected by an approved opening protective assembly having a fire protection rating of 1½ hours, and constructed in accordance with the SBC. The storage room shall be protected by an automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 27.4.6 Detached storage structure.** A maximum of 70 m<sup>3</sup> of loose combustible fibers shall be stored in a detached structure suitably located, with openings protected against entrance of sparks. The structure shall not be occupied for any other purpose.

## SECTION 27.5 BALED STORAGE

- 27.5.1 Bale size and separation.** Baled combustible fibers shall be limited to single blocks or piles not more than 700 m<sup>3</sup> in volume, not including aisles or clearances. Blocks or piles of baled fiber shall be separated from adjacent storage by aisles not less than 1.5 m wide, or by flash-fire barriers constructed of continuous sheets of noncombustible material extending from the floor to a minimum height of 0.3 m above the highest point of the piles and projecting not less than 0.3 m beyond the sides of the piles.
- 27.5.2 Special baling conditions.** Sisal and other fibers in bales bound with combustible tie ropes, jute and other fibers that swell when wet, shall be stored to allow for expansion in any direction without affecting building walls, ceilings or columns. A minimum clearance of 900 mm shall be required between walls and sides of piles, except that where the storage compartment is not more than 9.1 m wide, the minimum clearance at side walls shall be 0.3 m, provided that a center aisle not less than 1.5 m wide is maintained.

## CHAPTER 28 COMPRESSED GASES

### SECTION 28.1 GENERAL

**28.1.1 Scope.** Storage, use and handling of compressed gases in compressed gas containers, cylinders, tanks and systems shall comply with this chapter, including those gases regulated elsewhere in these code requirements. Partially full compressed gas containers, cylinders or tanks containing residual gases shall be considered as full for the purposes of the controls required.

**Exceptions:**

1. Gases used as refrigerants in refrigeration systems (see Section 5D.6).
2. Compressed natural gas (CNG) for use as a vehicular fuel shall comply with Chapter 20 and NFPA 52.

Cutting and welding gases shall also comply with Chapter 25.

Cryogenic fluids shall also comply with Chapter 30. Liquefied natural gas for use as a vehicular fuel shall also comply with NFPA 57 and NFPA 59A.

Compressed gases classified as hazardous materials shall also comply with Chapter 25 for general requirements and chapters addressing specific hazards, including Chapters 33 (Flammable Gases), 35 (Highly Toxic and Toxic Materials), 38 (Oxidizers) and 39 (Pyrophoric).

LP-gas shall also comply with Chapter 36.

**28.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 28.2 DEFINITIONS

**28.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**COMPRESSED GAS.** A material or mixture of materials which:

1. Is a gas at 20°C or less at 101 kPa of pressure; and
2. Has a boiling point of 20°C or less at 101 kPa which is either liquefied, nonliquefied or in solution, except those gases which have no other health or physical-hazard properties are not considered to be compressed until the pressure in the packaging exceeds 28 kPa at 20°C.

The states of a compressed gas are categorized as follows:

1. Nonliquefied compressed gases are gases, other than those in solution, which are in a packaging under the charged pressure and are entirely gaseous at a temperature of 20°C.
2. Liquefied compressed gases are gases that, in a packaging under the charged pressure, are partially liquid at a temperature of 20°C.
3. Compressed gases in solution are nonliquefied gases that are dissolved in a solvent.
4. Compressed gas mixtures consist of a mixture of two or more compressed gases contained in a packaging, the hazard properties of which are represented by the properties of the mixture as a whole.

**COMPRESSED GAS CONTAINER.** A pressure vessel designed to hold compressed gases at pressures greater than one atmosphere at 20°C and includes

cylinders, containers and tanks.

**COMPRESSED GAS SYSTEM.** An assembly of equipment designed to contain, distribute or transport compressed gases. It can consist of a compressed gas container or containers, reactors and appurtenances, including pumps, compressors and connecting piping and tubing.

**NESTING.** A method of securing flat-bottomed compressed gas cylinders upright in a tight mass using a contiguous three-point contact system whereby all cylinders within a group have a minimum of three points of contact with other cylinders, walls or bracing.

### SECTION 28.3 GENERAL REQUIREMENTS

- 28.3.1 Containers, cylinders and tanks.** Compressed gas containers, cylinders and tanks shall comply with this section. Compressed gas containers, cylinders or tanks that are not designed for refillable use shall not be refilled after use of the original contents.
- 28.3.2 Marking.** Stationary and portable compressed gas containers, cylinders, tanks and systems shall be marked in accordance with Sections 28.3.2.1, 28.3.2.2 and 28.3.2.3.
- 28.3.2.1 Stationary compressed gas containers, cylinders and tanks.** Stationary compressed gas containers, cylinders and tanks shall be marked with the name of the gas and in accordance with Sections 25.3.5 and 25.3.5. Markings shall be visible from any direction of approach.
- 28.3.2.2 Portable containers, cylinders and tanks.** Portable compressed gas containers, cylinders and tanks shall be marked in accordance with CGA C-7.
- 28.3.2.3 Piping systems.** Piping systems shall be marked in accordance with ANSI A13.1. Markings used for piping systems shall consist of the content's name and include a direction-of-flow arrow. Markings shall be provided at each valve; at wall, floor or ceiling penetrations; at each change of direction; and at a minimum of every 6.1 m or fraction thereof throughout the piping run.
- Exceptions:**
1. Piping that is designed or intended to carry more than one gas at various times shall have appropriate signs or markings posted at the manifold, along the piping and at each point of use to provide clear identification and warning.
  2. Piping within gas-manufacturing plants, gas-processing plants, refineries and similar occupancies shall be marked in an approved manner.
- 28.3.3 Security.** Compressed gas containers, cylinders, tanks and systems shall be secured against accidental dislodgement and against access by unauthorized personnel in accordance with Sections 28.3.3.1 through 28.3.3.3.
- 28.3.3.1 Security of areas.** Areas used for the storage, use and handling of compressed gas containers, cylinders, tanks and systems shall be secured against unauthorized entry and safeguarded in an approved manner.
- 28.3.3.2 Physical protection.** Compressed gas containers, cylinders, tanks and systems which could be exposed to physical damage shall be protected. Guard posts or other approved means shall be provided to protect compressed gas containers, cylinders, tanks and systems indoors and outdoors from vehicular damage and shall comply with Section 5A.12.



- 28.3.3.3 Securing compressed gas containers, cylinders and tanks.** Compressed gas containers, cylinders and tanks shall be secured to prevent falling caused by contact, vibration or seismic activity. Securing of compressed gas containers, cylinders and tanks shall be by one of the following methods:
1. Securing containers, cylinders and tanks to a fixed object with one or more restraints.
  2. Securing containers, cylinders and tanks on a cart or other mobile device designed for the movement of compressed gas containers, cylinders or tanks.
  3. Nesting of compressed gas containers, cylinders and tanks at container filling or servicing facilities or in seller's warehouses not accessible to the public. Nesting shall be allowed provided the nested containers, cylinders or tanks, if dislodged, do not obstruct the required means of egress.
  4. Securing of compressed gas containers, cylinders and tanks to or within a rack, framework, cabinet or similar assembly designed for such use.
- Exception:** Compressed gas containers, cylinders and tanks in the process of examination, filling, transport or servicing.
- 28.3.4 Valve protection.** Compressed gas container, cylinder and tank valves shall be protected from physical damage by means of protective caps, collars or similar devices in accordance with Sections 28.3.4.1 and 28.3.4.2.
- 28.3.4.1 Compressed gas container, cylinder or tank protective caps or collars.** Compressed gas containers, cylinders and tanks designed for protective caps, collars or other protective devices shall have the caps or devices in place except when the containers, cylinders or tanks are in use or are being serviced or filled.
- 28.3.4.2 Caps and plugs.** Compressed gas containers, cylinders and tanks designed for valve protection caps or other protective devices shall have the caps or devices attached. When outlet caps or plugs are installed, they shall be in place.
- Exception:** Compressed gas containers, cylinders or tanks in use, being serviced or being filled.
- 28.3.5 Separation from hazardous conditions.** Compressed gas containers, cylinders and tanks and systems in storage or use shall be separated from materials and conditions which pose exposure hazards to or from each other. Compressed gas containers, cylinders, tanks and systems in storage or use shall be separated in accordance with Sections 28.3.5.1 through 28.3.5.10.
- 28.3.5.1 Incompatible materials.** Compressed gas containers, cylinders and tanks shall be separated from each other based on the hazard class of their contents. Compressed gas containers, cylinders and tanks shall be separated from incompatible materials in accordance with Section 25.3.9.8.
- 28.3.5.2 Combustible waste, vegetation and similar materials.** Combustible waste, vegetation and similar materials shall be kept a minimum of 3.1 m from compressed gas containers, cylinders, tanks and systems. A noncombustible partition, without openings or penetrations and extending not less than 460 mm above and to the sides of the storage area is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.
- 28.3.5.3 Ledges, platforms and elevators.** Compressed gas containers, cylinders and tanks shall not be placed near elevators, unprotected platform ledges or other areas where falling would result in compressed gas containers, cylinders or tanks being allowed to drop distances exceeding one-half the height of the container, cylinder or tank.
- 28.3.5.4 Temperature extremes.** Compressed gas containers, cylinders and tanks, whether full or partially full, shall not be exposed to artificially create high temperatures

exceeding 52°C or sub-ambient (low) temperatures unless designed for use under the exposed conditions.

- 28.3.5.5 Falling objects.** Compressed gas containers, cylinders, tanks and systems shall not be placed in areas where they are capable of being damaged by falling objects.
- 28.3.5.6 Heating.** Compressed gas containers, cylinders and tanks, whether full or partially full, shall not be heated by devices which could raise the surface temperature of the container, cylinder or tank to above 52°C. Heating devices shall comply with the SBC 401 and the SBC 501 Approved heating methods involving temperatures of less than 52°C are allowed to be used by trained personnel. Devices designed to maintain individual compressed gas containers, cylinders or tanks at constant temperature shall be approved and shall be designed to fail safe.
- 28.3.5.7 Sources of ignition.** Open flames and high-temperature devices shall not be used in a manner which creates a hazardous condition.
- 28.3.5.8 Exposure to chemicals.** Compressed gas containers, cylinders, tanks and systems shall not be exposed to corrosive chemicals or fumes which could damage containers, cylinders, tanks, valves or valve-protective caps.
- 28.3.5.9 Exhausted enclosures.** When exhausted enclosures are provided as a means to segregate compressed gas containers, cylinders and tanks from exposure hazards, such enclosures shall comply with the requirements of Section 25.3.8.5.
- 28.3.5.10 Gas cabinets.** When gas cabinets are provided as a means to separate compressed gas containers, cylinders and tanks from exposure hazards, such gas cabinets shall comply with the requirements of Section 25.3.8.6.
- 28.3.6 Wiring and equipment.** Electrical wiring and equipment shall comply with the SBC 401. Compressed gas containers, cylinders, tanks and systems shall not be located where they could become part of an electrical circuit. Compressed gas containers, cylinders, tanks and systems shall not be used for electrical grounding.
- 28.3.7 Service and repair.** Service, repair, modification or removal of valves, pressure-relief devices or other compressed gas container, cylinder or tank appurtenances shall be performed by trained personnel.
- 28.3.8 Unauthorized use.** Compressed gas containers, cylinders, tanks and systems shall not be used for any purpose other than to serve as a vessel for containing the product which it is designed to contain.
- 28.3.9 Exposure to fire.** Compressed gas containers, cylinders and tanks which have been exposed to fire shall be removed from service. Containers, cylinders and tanks so removed shall be handled by approved qualified persons.
- 28.3.10 Leaks, damage or corrosion.** Leaking, damaged or corroded compressed gas containers, cylinders and tanks shall be removed from service. Leaking, damaged or corroded compressed gas systems shall be replaced or repaired in accordance with the following:
1. Compressed gas containers, cylinders and tanks which have been removed from service shall be handled in an approved manner.
  2. Compressed gas systems which are determined to be leaking, damaged or corroded shall be repaired to a serviceable condition or removed from service.
- 28.3.11 Surface of unprotected storage or use areas.** Unless otherwise specified in Section 28.3.12, compressed gas containers, cylinders and tanks are allowed to be stored or used without being placed under overhead cover. To prevent bottom

corrosion, containers, cylinders and tanks shall be protected from direct contact with soil or unimproved surfaces. The surface of the area on which the containers are placed shall be graded to prevent accumulation of water.

- 28.3.12 Overhead cover.** Compressed gas containers, cylinders and tanks are allowed to be stored or used in the sun except in locations where extreme temperatures prevail. When extreme temperatures prevail, overhead covers shall be provided.
- 28.3.13 Lighting.** Approved lighting by natural or artificial means shall be provided.

## SECTION 28.4 STORAGE OF COMPRESSED GASES

- 28.4.1 Upright storage.** Compressed gas containers, cylinders and tanks, except those designed for use in a horizontal position, and all compressed gas containers, cylinders and tanks containing nonliquefied gases, shall be stored in an upright position with the valve end up. An upright position shall include conditions where the container, cylinder or tank axis is inclined as much as 45 degrees (0.80 rad) from the vertical.
- Exceptions:**
1. Compressed gas containers with a water volume less than 5 L are allowed to be stored in a horizontal position.
  2. Cylinders, containers and tanks containing nonflammable gases or cylinders, containers and tanks containing nonliquefied flammable gases, which have been secured to a pallet for transportation purposes.
- 28.4.2 Material-specific regulations.** In addition to the requirements of this section, indoor and outdoor storage of compressed gases shall comply with the material-specific provisions of Chapters 29, 33 and 35 through 42.

## SECTION 28.5 USE AND HANDLING OF COMPRESSED GASES

- 28.5.1 Compressed gas systems.** Compressed gas systems shall be suitable for the use intended and shall be designed by persons competent in such design. Compressed gas equipment, machinery and processes shall be listed or approved.
- 28.5.2 Controls.** Compressed gas system controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls shall be designed to be fail safe.
- 28.5.3 Piping systems.** Piping, including tubing, valves, fittings and pressure regulators, shall comply with this section and Chapter 25. Piping, tubing, pressure regulators, valves and other apparatus shall be kept gas tight to prevent leakage.
- 28.5.4 Valves.** Valves utilized on compressed gas systems shall be suitable for the use intended and shall be accessible. Valve handles or operators for required shutoff valves shall not be removed or otherwise altered to prevent access.
- 28.5.5 Venting.** Venting of gases shall be directed to an approved location. Venting shall comply with the SBC 501.

- 28.5.6 Upright use.** Compressed gas containers, cylinders and tanks, except those designed for use in a horizontal position, and all compressed gas containers, cylinders and tanks containing nonliquefied gases, shall be used in an upright position with the valve end up. An upright position shall include conditions where the container, cylinder or tank axis is inclined as much as 0.80 rad from the vertical. Use of nonflammable liquefied gases in the inverted position when the liquid phase is used shall not be prohibited provided that the container, cylinder or tank is properly secured and the dispensing apparatus is designed for liquefied gas use.  
**Exception:** Compressed gas containers, cylinders and tanks with a water volume less than 5 L are allowed to be used in a horizontal position.
- 28.5.7 Transfer.** Transfer of gases between containers, cylinders and tanks shall be performed by qualified personnel using equipment and operating procedures in accordance with CGA P-1.  
**Exception:** Fueling of vehicles with compressed natural gas (CNG).
- 28.5.8 Use of compressed gas for inflation.** Inflatable equipment, devices or balloons shall only be pressurized or filled with compressed air or inert gases.
- 28.5.9 Material-specific regulations.** In addition to the requirements of this section, indoor and outdoor use of compressed gases shall comply with the material-specific provisions of Chapters 29, 33 and 35 through 42.
- 28.5.10 Handling.** The handling of compressed gas containers, cylinders and tanks shall comply with Sections 28.5.10.1 and 28.5.10.2.
- 28.5.10.1 Carts and trucks.** Containers, cylinders and tanks shall be moved using an approved method. Where containers, cylinders or tanks are moved by hand cart, hand truck or other mobile device, such carts, trucks or devices shall be designed for the secure movement of containers, cylinders or tanks. Carts and trucks utilized for transport of compressed gas containers, cylinders and tanks within buildings shall comply with Section 25.3.10. Carts and trucks utilized for transport of compressed gas containers, cylinders and tanks exterior to buildings shall be designed so that the containers, cylinders and tanks will be secured against dropping or otherwise striking against each other or other surfaces.
- 28.5.10.2 Lifting devices.** Ropes, chains or slings shall not be used to suspend compressed gas containers, cylinders and tanks unless provisions at time of manufacture have been made on the container, cylinder or tank for appropriate lifting attachments, such as lugs.

## SECTION 28.6

### MEDICAL GAS SYSTEMS

- 28.6.1 General.** Compressed gases at hospitals and similar facilities intended for inhalation or sedation including, but not limited to, analgesia systems for dentistry, podiatry, veterinary and similar uses shall comply with this section in addition to other requirements of this chapter.
- 28.6.2 Interior supply location.** Medical gases shall be stored in areas dedicated to the storage of such gases without other storage or uses. Where containers of medical gases in quantities greater than the permit amount are located inside buildings, they shall be in a 1 hour exterior room, a 1 hour interior room or a gas cabinet in accordance with Section 28.6.2.1, 28.6.2.2 or 28.6.2.3.

- 28.6.2.1 One hour exterior rooms.** A 1 hour exterior room shall be a room or enclosure separated from the remainder of the building by fire barriers with a fire-resistance rating of not less than 1 hour. Openings between the room or enclosure and interior spaces shall be self-closing smoke and draft-control assemblies having a fire protection rating of not less than 1 hour. Rooms shall have at least one exterior wall that is provided with at least two vents. Each vent shall not be less than  $0.023 \text{ m}^2$  in area. One vent shall be within 152 mm of the floor and one shall be within 152 mm of the ceiling. Rooms shall be provided with at least one automatic sprinkler to provide container cooling in case of fire.
- 28.6.2.2 One-hour interior room.** When an exterior wall cannot be provided for the room, automatic sprinklers shall be installed within the room. The room shall be exhausted through a duct to the exterior. Supply and exhaust ducts shall be enclosed in a 1-hour-rated shaft enclosure from the room to the exterior. Approved mechanical ventilation shall comply with the SBC 501 and be provided at a minimum rate of  $0.0051 \text{ m}^3/(\text{s} \cdot \text{m}^2)$  of the area of the room.
- 28.6.2.3 Gas cabinets.** Gas cabinets shall be constructed in accordance with Section 25.3.8.6 and the following:
1. The average velocity of ventilation at the face of access ports or windows shall not be less than 61 m/s with a minimum of 46 m/s at any point of the access port or window.
  2. Connected to an exhaust system.
  3. Internally sprinklered.
- 28.6.3 Exterior supply locations.** Oxidizer medical gas systems located on the exterior of a building with quantities greater than the permit amount shall be located in accordance with Section 38.4.2.1.
- 28.6.4 Medical gas systems.** Medical gas systems including, but not limited to, distribution piping, supply manifolds, connections, pressure regulators, and relief devices and valves, shall comply with NFPA 99 and the general provisions of this chapter.

## SECTION 28.7

### COMPRESSED GASES NOT OTHERWISE REGULATED

- 28.7.1 General.** Compressed gases in storage or use not regulated by the material-specific provisions of Chapters 5, 29, 33 and 35 through 42, including asphyxiant, irritant and radioactive gases, shall comply with this section in addition to other requirements of this chapter.
- 28.7.2 Ventilation.** Indoor storage and use areas and storage buildings shall be provided with mechanical exhaust ventilation or natural ventilation in accordance with the requirements of Section 25.4.3 or 25.5.1.9. When mechanical ventilation is provided, the systems shall be operational during such time as the building or space is occupied.



## CHAPTER 29 CORROSIVE MATERIALS

### SECTION 29.1 GENERAL

- 29.1.1 Scope.** The storage and use of corrosive materials shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 28.
- Exceptions:**
1. Display and storage in Group M and storage in Group S occupancies complying with Section 25.3.11.
  2. Stationary lead-acid battery systems in accordance with Section 5D.8.
  3. This chapter shall not apply to R-717 (ammonia) where used as a refrigerant in a refrigeration system (see Section 5D.6).
- 29.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 29.2 DEFINITIONS

- 29.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**CORROSIVE.** A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. A chemical shall be considered corrosive if such chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of 4 hours. This term does not refer to action on inanimate surfaces.

### SECTION 29.3 GENERAL REQUIREMENTS

- 29.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of corrosive materials in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3 and 29.1.
- 29.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of corrosive materials in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with this chapter and Chapter 25.

### SECTION 29.4 STORAGE

- 29.4.1 Indoor storage.** Indoor storage of corrosive materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(2) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.
- 29.4.1.1 Liquid-tight floor.** In addition to the provisions of Section 25.4.12, floors in storage areas for corrosive liquids shall be of liquid-tight construction.
- 29.4.2 Outdoor storage.** Outdoor storage of corrosive materials in amounts exceeding the

maximum allowable quantity per control area indicated in Table 25.3.1.1(4) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.

**29.4.2.1 Above-ground outside storage tanks.** Above-ground outside storage tanks exceeding an aggregate quantity of 3,785 L of corrosive liquids shall be provided with secondary containment in accordance with Section 25.4.2.2.

**29.4.2.2 Distance from storage to exposures.** Outdoor storage of corrosive materials shall not be within 6.1 m of buildings not associated with the manufacturing or distribution of such materials, lot lines, public streets, public alleys, public ways or means of egress. A 2 hours fire barrier wall without openings or penetrations, and extending not less than 762 mm above and to the sides of the storage area is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.

## SECTION 29.5 USE

**29.5.1 Indoor use.** The indoor use of corrosive materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(2) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter.

**29.5.1.1 Liquid transfer.** Corrosive liquids shall be transferred in accordance with Section 25.5.1.10.

**29.5.1.2 Ventilation.** When corrosive materials are dispensed or used, mechanical exhaust ventilation in accordance with Section 25.5.2.1.1 shall be provided.

**29.5.2 Outdoor use.** The outdoor use of corrosive materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(4) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter.

**29.5.2.1 Distance from use to exposures.** Outdoor use of corrosive materials shall be located in accordance with Section 29.4.2.2.



## CHAPTER 30 CRYOGENIC FLUIDS

### SECTION 30.1 GENERAL

**30.1.1 Scope.** Storage, use and handling of cryogenic fluids shall comply with this chapter. Cryogenic fluids classified as hazardous materials shall also comply with Chapter 25 for general requirements. Partially full containers having residual cryogenic fluids shall be considered as full for the purposes of the controls required.

**Exceptions:**

1. Fluids used as refrigerants in refrigeration systems (see Section 5D.6).
2. Liquefied natural gas (LNG). Liquefied natural gas shall comply with NFPA 59A.

Oxidizing cryogenic fluids, including oxygen, shall comply with NFPA 50.

Flammable cryogenic fluids, including hydrogen, methane and carbon monoxide, shall comply with NFPA 50B.

Inert cryogenic fluids, including argon, helium and nitrogen, shall comply with CGA P-18.

**30.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 30.2 DEFINITIONS

**30.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in the SBC, have the meanings shown herein.

**CRYOGENIC CONTAINER.** A cryogenic vessel of any size used for the transportation, handling or storage of cryogenic fluids.

**CRYOGENIC FLUID.** A fluid having a boiling point lower than -89.9°C at an absolute pressure of 101.3 kPa.

**CRYOGENIC VESSEL.** A pressure vessel, low-pressure tank or atmospheric tank designed to contain a cryogenic fluid on which venting, insulation, refrigeration or a combination of these is used in order to maintain the operating pressure within the design pressure and the contents in a liquid phase.

**FLAMMABLE CRYOGENIC FLUID.** A cryogenic fluid that is flammable in its vapor state.

**LOW-PRESSURE TANK.** A storage tank designed to withstand an internal pressure greater than 3.4 kPa but not greater than 103.4 kPa.

### SECTION 30.3 GENERAL REQUIREMENTS

**30.3.1 Containers.** Containers employed for storage or use of cryogenic fluids shall comply with Sections 30.3.1.1 through 30.3.1.3.2 and Chapter 25.

- 30.3.1.1 Nonstandard containers.** Containers, equipment and devices which are not in compliance with recognized standards for design and construction shall be approved upon presentation of satisfactory evidence that they are designed and constructed for safe operation.
- 30.3.1.1.1 Data submitted for approval.** The following data shall be submitted to the building code official with reference to the deviation from the recognized standard with the application for approval.
1. Type and use of container, equipment or device.
  2. Material to be stored, used or transported.
  3. Description showing dimensions and materials used in construction.
  4. Design pressure, maximum operating pressure and test pressure.
  5. Type, size and setting of pressure relief devices.
  6. Other data requested by the building code official.
- 30.3.1.2 Concrete containers.** Concrete containers shall be built in accordance with the SBC 304. Barrier materials and membranes used in connection with concrete, but not functioning structurally, shall be compatible with the materials contained.
- 30.3.1.3 Foundations and supports.** Containers shall be provided with substantial concrete or masonry foundations, or structural steel supports on firm concrete or masonry foundations. Containers shall be supported to prevent the concentration of excessive loads on the supporting portion of the shell. Foundations for horizontal containers shall be constructed to accommodate expansion and contraction of the container. Foundations shall be provided to support the weight of vaporizers or heat exchangers.
- 30.3.1.3.1 Temperature effects.** When container foundations or supports are subject to exposure to temperatures below  $-101^{\circ}\text{C}$ , the foundations or supports shall be constructed of materials to withstand the low-temperature effects of cryogenic fluid spillage.
- 30.3.1.3.2 Corrosion protection.** Portions of containers in contact with foundations or saddles shall be painted to protect against corrosion.
- 30.3.2 Pressure relief devices.** Pressure relief devices shall be provided in accordance with Sections 30.3.2.1 through 30.3.2.7 to protect containers and systems containing cryogenic fluids from rupture in the event of overpressure. Pressure relief devices shall be designed in accordance with CGA S-1.1, CGA S-1.2 and CGA S-1.3.
- 30.3.2.1 Containers.** Containers shall be provided with pressure relief devices.
- 30.3.2.2 Vessels or equipment other than containers.** Heat exchangers, vaporizers, insulation casings surrounding containers, vessels and coaxial piping systems in which liquefied cryogenic fluids could be trapped because of leakage from the primary container shall be provided with a pressure relief device.
- 30.3.2.3 Sizing.** Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated. The relief device shall have sufficient capacity to prevent the maximum design pressure of the container or system from being exceeded.
- 30.3.2.4 Accessibility.** Pressure relief devices shall be located such that they are provided with ready access for inspection and repair.
- 30.3.2.5 Arrangement.** Pressure relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to prevent impingement of escaping gas on personnel, containers, equipment and adjacent structures or to enter enclosed spaces.
- Exception:** MOI or (DOTn)-specified containers with an internal volume of  $0.057\text{m}^3$  or less.

- 30.3.2.6 Shutoffs between pressure relief devices and containers.** Shutoff valves shall not be installed between pressure relief devices and containers.  
**Exception:** A shutoff valve is allowed on containers equipped with multiple pressure-relief device installations where the arrangement of the valves provides the full required flow through the minimum number of required relief devices at all times.
- 30.3.2.7 Temperature limits.** Pressure relief devices shall not be subjected to cryogenic fluid temperatures except when operating.
- 30.3.3 Pressure-relief vent piping.** Pressure-relief vent-piping systems shall be constructed and arranged so as to remain functional and direct the flow of gas to a safe location in accordance with Sections 30.3.3.1 and 30.3.3.2.
- 30.3.3.1 Sizing.** Pressure-relief-device vent piping shall have a cross-sectional area not less than that of the pressure-relief-device vent opening and shall be arranged so as not to restrict the flow of escaping gas.
- 30.3.3.2 Arrangement.** Pressure-relief-device vent piping and drains in vent lines shall be arranged so that escaping gas will discharge unobstructed to the open air and not impinge on personnel, containers, equipment and adjacent structures or enter enclosed spaces. Pressure-relief-device vent lines shall be installed in such a manner to exclude or remove moisture and condensation and prevent malfunction of the pressure relief device because of freezing or ice accumulation.
- 30.3.4 Marking.** Cryogenic containers and systems shall be marked in accordance with Sections 30.3.4.1 through 30.3.4.6.
- 30.3.4.1 Identification signs.** Visible hazard identification signs in accordance with NFPA 704 shall be provided at entrances to buildings or areas in which cryogenic fluids are stored, handled or used.
- 30.3.4.2 Identification of contents.** Stationary and portable containers shall be marked with the name of the gas contained. Stationary above-ground containers shall be placarded in accordance with Sections 25.3.5 and 25.3.6. Portable containers shall be identified in accordance with CGA C-7.
- 30.3.4.3 Identification of containers.** Stationary containers shall be identified with the manufacturing specification and maximum allowable working pressure with a permanent nameplate. The nameplate shall be installed on the container in an accessible location. The nameplate shall be marked in accordance with the ASME Boiler and Pressure Vessel Code.
- 30.3.4.4 Identification of container connections.** Container inlet and outlet connections, liquid-level limit controls, valves and pressure gauges shall be identified in accordance with one of the following: marked with a permanent tag or label identifying their function, or identified by a schematic drawing which portrays their function and designates whether they are connected to the vapor or liquid space of the container. Where a schematic drawing is provided, it shall be attached to the container and maintained in a legible condition.
- 30.3.4.5 Identification of piping systems.** Piping systems shall be identified in accordance with ANSI A13.1.
- 30.3.4.6 Identification of emergency shutoff valves.** Emergency shutoff valves shall be identified and the location shall be clearly visible and indicated by means of a sign.
- 30.3.5 Security.** Cryogenic containers and systems shall be secured against accidental dislodgement and against access by unauthorized personnel in accordance with Sections 30.3.5.1 through 30.3.5.4.

- 30.3.5.1 Security of areas.** Containers and systems shall be secured against unauthorized entry and safeguarded in an approved manner.
- 30.3.5.2 Securing of containers.** Stationary containers shall be secured to foundations in accordance with the SBC 201 and 303. Portable containers subject to shifting or upset shall be secured. Nesting shall be an acceptable means of securing containers.
- 30.3.5.3 Securing of vaporizers.** Vaporizers, heat exchangers and similar equipment shall be anchored to a suitable foundation and its connecting piping shall be sufficiently flexible to provide for the effects of expansion and contraction due to temperature changes.
- 30.3.5.4 Physical protection.** Containers, piping, valves, pressure relief devices, regulating equipment and other appurtenances shall be protected against physical damage and tampering.
- 30.3.6 Separation from hazardous conditions.** Cryogenic containers and systems in storage or use shall be separated from materials and conditions which pose exposure hazards to or from each other in accordance with Sections 30.3.6.1 through 30.3.6.2.1.
- 30.3.6.1 Stationary containers.** Stationary containers shall be separated from exposure hazards in accordance with the provisions applicable to the type of fluid contained and the minimum separation distances indicated in Table 30.3.6.1.

**TABLE 30.3.6.1  
SEPARATION OF STATIONARY CONTAINERS FROM  
EXPOSURE HAZARDS**

<b>EXPOSURE</b>	<b>MINIMUM DISTANCE (meter)</b>
Building, regardless of construction type	0.3
Wall openings	0.3
Air intakes	3.1
Lot lines	1.5
Places of public assembly	15.3
Nonambulatory patient areas	15.3
Combustible materials such as paper, leaves, weeds, dry grass or debris	4.6
Other hazardous materials	In accordance with Chapter 25

- 30.3.6.1.1 Point-of-fill connections.** Remote transfer points and fill connection points shall not be positioned closer to exposures than the minimum distances required for stationary containers.
- 30.3.6.1.2 Surfaces beneath containers.** The surface of the area on which stationary containers are placed, including the surface of the area located below the point where connections are made for the purpose of filling such containers, shall be compatible with the fluid in the container.
- 30.3.6.2 Portable containers.** Portable containers shall be separated from exposure hazards in accordance with Table 30.3.6.2.

**TABLE 30.3.6.2**  
**SEPARATION OF PORTABLE CONTAINERS FROM EXPOSURE HAZARDS**

<b>EXPOSURE</b>	<b>MINIMUM DISTANCE (meter)</b>
Building, exits	3.1
Wall openings	0.3
Air intakes	3.1
Lot lines	1.5
Room or area exits	0.9
Combustible materials such as paper, leaves, weeds, dry grass or debris	4.6
Other hazardous materials	In accordance with Chapter 25

- 30.3.6.2.1 Surfaces beneath containers.** Containers shall be placed on surfaces that are compatible with the fluid in the container.
- 30.3.7 Electrical wiring and equipment.** Electrical wiring and equipment shall comply with the SBC 401 and Sections 30.3.7.1 and 30.3.7.2.
- 30.3.7.1 Location.** Containers and systems shall not be located where they could become part of an electrical circuit.
- 30.3.7.2 Electrical grounding and bonding.** Containers and systems shall not be used for electrical grounding. When electrical grounding and bonding is required, the system shall comply with the SBC 401. The grounding system shall be protected against corrosion, including corrosion caused by stray electric currents.
- 30.3.8 Service and repair.** Service, repair, modification or removal of valves, pressure relief devices or other container appurtenances, shall comply with Sections 30.3.8.1 and 30.3.8.2 and the ASME Boiler and Pressure Vessel Code, Section VIII.
- 30.3.8.1 Containers.** Containers that have been removed from service shall be handled in an approved manner.
- 30.3.8.2 Systems.** Service and repair of systems shall be performed by trained personnel.
- 30.3.9 Unauthorized use.** Containers shall not be used for any purpose other than to serve as a vessel for containing the product which it is designed to contain.
- 30.3.10 Leaks, damage and corrosion.** Leaking, damaged or corroded containers shall be removed from service. Leaking, damaged or corroded systems shall be replaced, repaired or removed in accordance with Section 30.3.8.
- 30.3.11 Lighting.** When required, lighting, including emergency lighting, shall be provided for fire appliances and operating facilities such as walkways, control valves and gates ancillary to stationary containers.

## **SECTION 30.4**

### **STORAGE**

- 30.4.1 General.** Storage of containers shall comply with this section.
- 30.4.2 Indoor storage.** Indoor storage of containers shall be in accordance with Sections

30.4.2.1 through 30.4.2.2.3.

**30.4.2.1 Stationary containers.** Stationary containers shall be installed in accordance with the provisions applicable to the type of fluid stored and this section.

**30.4.2.1.1 Containers.** Stationary containers shall comply with Section 30.3.1.

**30.4.2.1.2 Construction of indoor areas.** Cryogenic fluids in stationary containers stored indoors shall be located in buildings, rooms or areas constructed in accordance with the SBC requirements.

**30.4.2.1.3 Ventilation.** Storage areas for stationary containers shall be ventilated in accordance with the SBC 501.

**30.4.2.2 Portable containers.** Indoor storage of portable containers shall comply with the provisions applicable to the type of fluid stored and Sections 30.4.2.2.1 through 30.4.2.2.3.

**30.4.2.2.1 Containers.** Portable containers shall comply with Section 30.3.1.

**30.4.2.2.2 Construction of indoor areas.** Cryogenic fluids in portable containers stored indoors shall be stored in buildings, rooms or areas constructed in accordance with the SBC requirements.

**30.4.2.2.3 Ventilation.** Storage areas shall be ventilated in accordance with the SBC 501.

**30.4.3 Outdoor storage.** Outdoor storage of containers shall be in accordance with Sections 30.4.3.1 through 30.4.3.2.2.

**30.4.3.1 Stationary containers.** The outdoor storage of stationary containers shall comply with Section 30.3 and this section.

**30.4.3.1.1 Location.** Stationary containers shall be located in accordance with Section 30.3.6. Containers of cryogenic fluids shall not be located within dike areas containing other hazardous materials.

**30.4.3.1.2 Areas subject to flooding.** Stationary containers located in areas subject to flooding shall be securely anchored or elevated to prevent the containers from separating from foundations or supports.

**30.4.3.1.3 Drainage.** The area surrounding stationary containers shall be provided with a means to prevent accidental discharge of fluids from endangering personnel, containers, equipment and adjacent structures or to enter enclosed spaces. The stationary container shall not be placed where spilled or discharged fluids will be retained around the container.

**Exception:** These provisions shall not apply when it is determined by the building code official that the container does not constitute a hazard, after consideration of special features such as crushed rock utilized as a heat sink, topographical conditions, nature of occupancy, proximity to structures on the same or adjacent property, and the capacity and construction of containers and character of fluids to be stored.

**30.4.3.2 Portable containers.** Outdoor storage of portable containers shall comply with Section 30.3 and this section.

**30.4.3.2.1 Location.** Portable containers shall be located in accordance with Section 30.3.6.

**30.4.3.2.2 Drainage.** The area surrounding portable containers shall be provided with a means to prevent accidental discharge of fluids from endangering adjacent containers, buildings, equipment or adjoining property.

**Exception:** These provisions shall not apply when it is determined by the building code official that the container does not constitute a hazard.

## SECTION 30.5 USE AND HANDLING

**30.5.1 Applicability.** Use and handling of containers and systems shall comply with this

section.

- 30.5.1.1 Cryogenic fluid systems.** Cryogenic fluid systems shall be suitable for the use intended and designed by persons competent in such design. Equipment, machinery and processes shall be listed or approved.
- 30.5.1.2 Piping systems.** Piping, tubing, valves and joints and fittings conveying cryogenic fluids shall be installed in accordance with the material-specific provisions of Sections 30.1.1 and 30.5.1.2.1 through 30.5.1.2.6.
- 30.5.1.2.1 Design and construction.** Piping systems shall be suitable for the use intended through the full range of pressure and temperature to which they will be subjected. Piping systems shall be designed and constructed to provide adequate allowance for expansion, contraction, vibration, settlement and fire exposure.
- 30.5.1.2.2 Joints.** Joints on container piping and tubing shall be threaded, welded, silver brazed or flanged.
- 30.5.1.2.3 Valves and accessory equipment.** Valves and accessory equipment shall be suitable for the intended use at the temperatures of the application and shall be designed and constructed to withstand the maximum pressure at the minimum temperature to which they will be subjected.
- 30.5.1.2.3.1 Shutoff valves on containers.** Shutoff valves shall be provided on all container connections except for pressure relief devices. Shutoff valves shall be provided with access thereto and located as close as practical to the container.
- 30.5.1.2.3.2 Shutoff valves on piping.** Shutoff valves shall be installed in piping containing cryogenic fluids where needed to limit the volume of liquid discharged in the event of piping or equipment failure. Pressure relief valves shall be installed where liquid is capable of being trapped between shutoff-valves in the piping system (see Section 30.3.2).
- 30.5.1.2.4 Physical protection and support.** Above-ground piping systems shall be supported and protected from physical damage. Piping passing through walls shall be protected from mechanical damage.
- 30.5.1.2.5 Corrosion protection.** Above-ground piping that is subject to corrosion because of exposure to corrosive atmospheres, shall be constructed of materials to resist the corrosive environment or otherwise protected against corrosion. Below-ground piping shall be protected against corrosion.
- 30.5.1.2.6 Testing.** Piping systems shall be tested and proven free of leaks after installation as required by the standards to which they were designed and constructed. Test pressures shall not be less than 150 percent of the maximum allowable working pressure when hydraulic testing is conducted or 110 percent when testing is conducted pneumatically.
- 30.5.2 Indoor use.** Indoor use of cryogenic fluids shall comply with the material-specific provisions of Section 30.1.1.
- 30.5.3 Outdoor use.** Outdoor use of cryogenic fluids shall comply with the material specific provisions of Sections 30.1.1, 30.5.3.1 and 30.5.3.2.
- 30.5.3.1 Separation.** Distances from property lines, buildings and exposure hazards shall comply with Section 30.3.6 and the material specific provisions of Section 30.1.1.
- 30.5.3.2 Emergency shutoff valves.** Readily available shutoff valves shall be provided to shut off the cryogenic fluid supply in case of emergency. A shutoff valve shall be located at the source of supply and at the point where the system enters the building.
- 30.5.4 Filling and dispensing.** Filling and dispensing of cryogenic fluids shall comply with Sections 30.5.4.1 through 30.5.4.3.

- 30.5.4.1 Dispensing areas.** Dispensing of cryogenic fluids with physical or health hazards shall be conducted in approved locations. Dispensing indoors shall be conducted in areas constructed in accordance with the SBC.
- 30.5.4.1.1 Ventilation.** Indoor areas where cryogenic fluids are dispensed shall be ventilated in accordance with the requirements of the SBC 501 in a manner that captures any vapor at the point of generation.  
**Exception:** Cryogenic fluids that can be demonstrated not to create harmful vapors.
- 30.5.4.1.2 Piping systems.** Piping systems utilized for filling or dispensing of cryogenic fluids shall be designed and constructed in accordance with Section 30.5.1.2.
- 30.5.4.2 Vehicle loading and unloading areas.** Loading or unloading areas shall be conducted in an approved manner in accordance with the standards referenced in Section 30.1.1.
- 30.5.4.3 Limit controls.** Limit controls shall be provided to prevent overfilling of stationary containers during filling operations.
- 30.5.5 Handling.** Handling of cryogenic containers shall comply with this section.
- 30.5.5.1 Carts and trucks.** Cryogenic containers shall be moved using an approved method. Where cryogenic containers are moved by hand cart, hand truck or other mobile device, such carts, trucks or devices shall be designed for the secure movement of the container.  
Carts and trucks used to transport cryogenic containers shall be designed to provide a stable base for the commodities to be transported and shall have a means of restraining containers to prevent accidental dislodgement.
- 30.5.5.2 Closed containers.** Pressurized containers shall be transported in a closed condition. Containers designed for use at atmospheric conditions shall be transported with appropriate loose fitting covers in place to prevent spillage.



## CHAPTER 31 EXPLOSIVES AND FIREWORKS

### SECTION 31.1 GENERAL

**31.1.1 Scope.** The provisions of this chapter shall govern the possession, manufacture, storage, handling, sale and use of explosives, explosive materials, fireworks and small arms ammunition.

**Exceptions:**

1. The Armed Forces of the Kingdom of Saudi Arabia, Coast Guard or National Guard.
2. Explosives in forms prescribed by the official Kingdom of Saudi Arabia Pharmacopoeia.
3. The possession, storage and use of small arms ammunition when packaged in accordance with MOI or (DOTn) packaging requirements.
4. The possession, storage, and use of not more than 0.5 kg of commercially manufactured sporting black powder, 9 kg of smokeless powder and 10,000 small arms primers for hand loading of small arms ammunition for personal consumption.
5. The use of explosive materials by local regulatory, law enforcement and Civil Defence acting in their official capacities.
6. Special industrial explosive devices which in the aggregate contain less than 23 kg of explosive materials.
7. The possession, storage and use of blank industrial-power load cartridges when packaged in accordance with MOI or (DOTn) packaging regulations.
8. Transportation in accordance with MOI or (DOTn 49 CFR Parts 100-178).
9. Items preempted by local regulations.

**31.1.1.1 Explosive material standard.** In addition to the requirements of this chapter, NFPA 495 shall govern the manufacture, transportation, storage, sale, handling and use of explosive materials.

**31.1.1.2 Explosive material terminals.** In addition to the requirements of this chapter, the operation of explosive material terminals shall conform to the provisions of NFPA 498.

**31.1.1.3 Fireworks.** The possession, manufacture, storage, sale, handling and use of fireworks are prohibited.

**Exceptions:**

1. Storage and handling of fireworks as permitted in Section 31.4.
2. Manufacture, assembly and testing of fireworks as permitted in Section 31.5.
3. The use of fireworks for display as permitted in Section 31.8.
4. The possession, storage, sale, handling and use of specific types of Division 1.4G fireworks where allowed by applicable local laws, ordinances and regulations provided such fireworks comply with CPSC 16 CFR, Parts 1500 and 1507, and DOTn 49 CFR, Parts 100-178, for consumer fireworks.

**31.1.1.4 Rocketry.** The storage, handling and use of model and high-power rockets shall comply with the requirements of NFPA 1122, NFPA 1125, and NFPA 1127.

**31.1.1.5 Ammonium nitrate.** The storage and handling of ammonium nitrate shall comply with the requirements of NFPA 490 and Chapter 38.

**Exception:** Storage of ammonium nitrate in magazines with blasting agents shall comply with the requirements of NFPA 495.

**31.1.2 Permit required.** Permits shall be required as set forth in SBC 100 and regulated in

accordance with this section.

- 31.1.2.1 Residential uses.** No person shall keep or store, nor shall any permit be issued to keep or store, any explosives at any place of habitation, or within 30.5 m thereof.  
**Exception:** Storage of smokeless propellant, black powder, and small arms primers for personal use and not for resale in accordance with Section 31.6.
- 31.1.2.2 Sale and retail display.** No person shall construct a retail display nor offer for sale explosives, explosive materials, or fireworks upon highways, sidewalks, public property, or in assembly or educational occupancies.
- 31.1.2.3 Permit restrictions.** The building code official is authorized to limit the quantity of explosives, explosive materials, or fireworks permitted at a given location. No person, possessing a permit for storage of explosives at any place, shall keep or store an amount greater than authorized in such permit. Only the kind of explosive specified in such a permit shall be kept or stored.
- 31.1.3 Prohibited explosives.** Permits shall not be issued or renewed for possession, manufacture, storage, handling, sale or use of the following materials and such materials currently in storage or use shall be disposed of in an approved manner:
1. Liquid nitroglycerin.
  2. Dynamite containing more than 60 percent liquid explosive ingredient.
  3. Dynamite having an unsatisfactory absorbent or one that permits leakage of a liquid explosive ingredient under any conditions liable to exist during storage.
  4. Nitrocellulose in a dry and uncompressed condition in a quantity greater than 4.5 kg of net weight in one package.
  5. Fulminate of mercury in a dry condition and fulminate of all other metals in any condition except as a component of manufactured articles not hereinafter forbidden.
  6. Explosive compositions that ignite spontaneously or undergo marked decomposition, rendering the products of their use more hazardous, when subjected for 48 consecutive hours or less to a temperature of 75°C.
  7. New explosive materials until approved by MOI, except that permits are allowed to be issued to educational, governmental or industrial laboratories for instructional or research purposes.
  8. Explosive materials condemned by MOI.
  9. Explosive materials containing an ammonium salt and a chlorate.
  10. Explosives not packed or marked as required by MOI.
- Exception:** Gelatin dynamite.
- 31.1.4 Qualifications.** Persons in charge of magazines, blasting, fireworks display, or pyrotechnic special effect operations shall not be under the influence of alcohol or drugs which impair sensory or motor skills, shall be at least 21 years of age, and shall demonstrate knowledge of all safety precautions related to the storage, handling or use of explosives, explosive materials or fireworks.
- 31.1.5 Supervision.** The building code official is authorized to require operations permitted under the provisions of Section 31.1.2 to be supervised at any time by the building code official in order to determine compliance with all safety and fire regulations.
- 31.1.6 Notification.** Whenever a new explosive material storage or manufacturing site is established, including a temporary job site, the local law enforcement agency, Civil Defence, shall be notified 48 hours in advance, not including Thursday, Friday and holidays, of the type, quantity and location of explosive materials at the site.

- 31.1.7 Seizure.** The building code official is authorized to remove or cause to be removed or disposed of in an approved manner, at the expense of the owner, explosives, explosive materials or fireworks offered or exposed for sale, stored, possessed or used in violation of this chapter.
- 31.1.8 Establishment of quantity of explosives and distances.** The quantity of explosives and distances shall be in accordance with Sections 31.1.8.1 and 31.1.8.1.1.
- 31.1.8.1 Quantity of explosives.** The quantity-distance tables in Sections 31.4.5 and 31.5.3 shall be used to provide appropriate distances from potential explosion sites. The classification of the explosives and the weight of the explosives are primary characteristics governing the use of these tables. The net explosive weight shall be determined in accordance with Sections 31.1.8.1.1 through 31.1.8.1.4.
- 31.1.8.1.1 Mass-detonating explosives.** The total net explosive weight of Division 1.1, 1.2 or 1.5 explosives shall be used. See Table 31.4.5.2(2) or Table 31.5.3 as appropriate.  
**Exception:** When the TNT equivalence of the explosive material has been determined, the equivalence is allowed to be used to establish the net explosive weight.
- 31.1.8.1.2 Non-mass-detonating explosives (excluding Division 1.4).** Non-mass-detonating explosives shall be as follows:
1. Division 1.3 propellants. The total weight of the propellants alone shall be the net explosive weight. The net weight of propellant shall be used. See Table 31.4.5.2(3).
  2. Combinations of bulk metal powder and pyrotechnic compositions. The sum of the net weights of metal powders and pyrotechnic compositions in the containers shall be the net explosive weight. See Table 31.4.5.2(3).
- 31.1.8.1.3 Combinations of mass-detonating and non-mass-detonating explosives (excluding Division 1.4).** Combination of mass-detonating and non-mass-detonating explosives shall be as follows:
1. When Divisions 1.1 and 1.2 explosives are located in the same site, determine the distance for the total quantity considered first as 1.1 and then as 1.2. The required distance is the greater of the two. When the Division 1.1 requirements are controlling and the TNT equivalence of the 1.2 is known, the TNT equivalent weight of the 1.2 items shall be allowed to be added to the total explosive weight of Division 1.1 items to determine the net explosive weight for Division 1.1 distance determination. See Table 31.4.5.2(3) or Table 31.5.3 as appropriate.
  2. When Divisions 1.1 and 1.3 explosives are located in the same site, determine the distances for the total quantity considered first as 1.1 and then as 1.3. The required distance is the greater of the two. When the Division 1.1 requirements are controlling and the TNT equivalence of the 1.3 is known, the TNT equivalent weight of the 1.3 items shall be allowed to be added to the total explosive weight of Division 1.1 items to determine the net explosive weight for Division 1.1 distance determination. See Table 31.4.5.2(2), 31.4.5.2(3) or 31.5.3, as appropriate.
  3. When Divisions 1.1, 1.2 and 1.3 explosives are located in the same site, determine the distances for the total quantity considered first as 1.1, next as 1.2 and finally as 1.3. The required distance is the greatest of the three. As permitted by paragraphs 1 and 2 above, TNT equivalent weights for 1.2 and 1.3 items are allowed to be used to determine the net weight of explosives for Division 1.1 distance determination. Table 31.4.5.2(2) or 31.5.3 shall be used when TNT equivalency is used to establish the net explosive weight.

4. For composite pyrotechnic items Division 1.1 and Division 1.3, the sum of the net weights of the pyrotechnic composition and the explosives involved shall be used. See Tables 31.4.5.2(2) and 31.4.5.2(3).

**31.1.8.1.4 Moderate fire – no blast hazards.** Division 1.4 explosives. The total weight of the explosive material alone is the net weight. The net weight of the explosive material shall be used. See Table 31.4.5.2(4).

## SECTION 31.2 DEFINITIONS

**31.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**AMMONIUM NITRATE.** A chemical compound represented by the formula  $\text{NH}_4\text{NO}_3$ .

**BARRICADE.** A structure that consists of a combination of walls, floor and roof, which is designed to withstand the rapid release of energy in an explosion and which is fully confined, partially vented or fully vented; or other effective method of shielding from explosive materials by a natural or artificial barrier.

**Artificial barricade.** An artificial mound or revetment a minimum thickness of 900 mm.

**Natural barricade.** Natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures that require protection cannot be seen from the magazine or building containing explosives when the trees are bare of leaves.

**BARRICADED.** The effective screening of a building containing explosive materials from the magazine or other building, railway, or highway by a natural or an artificial barrier. A straight line from the top of any sidewall of the building containing explosive materials to the eave line of any magazine or other building or to a point 3.7 m above the center of a railway or highway shall pass through such barrier.

**BLAST AREA.** The area including the blast site and the immediate adjacent area within the influence of flying rock, missiles and concussion.

**BLAST SITE.** The area in which explosive materials are being or have been loaded and which includes all holes loaded or to be loaded for the same blast and a distance of 15.3 m in all directions.

**BLASTER.** A person qualified in accordance with Section 31.1.4 to be in charge of and responsible for the loading and firing of a blast.

**BLASTING AGENT.** A material or mixture consisting of fuel and oxidizer, intended for blasting provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test detonator when unconfined. Blasting agents are labeled and placarded as Class 1.5 material by MOI or (US DOTn).

**BULLET RESISTANT.** Constructed so as to resist penetration of a bullet of 9.7 grams M2 ball ammunition having a nominal muzzle velocity of 824 mps when

fired from a 30-caliber rifle at a distance of 30.5 m, measured perpendicular to the target.

**DETONATING CORD.** A flexible cord containing a center core of high explosive used to initiate other explosives.

**DETONATION.** An exothermic reaction characterized by the presence of a shock wave in the material which establishes and maintains the reaction. The reaction zone progresses through the material at a rate greater than the velocity of sound. The principal heating mechanism is one of shock compression. Detonations have an explosive effect.

**DETONATOR.** A device containing any initiating or primary explosive that is used for initiating detonation. A detonator shall not contain more than 10 grams of total explosives by weight, excluding ignition or delay charges. The term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, detonating cord delay connectors, and non-instantaneous and delay blasting caps which use detonating cord, shock tube or any other replacement for electric leg wires. All types of detonators in strengths through No. 8 cap should be rated at 0.68 kg of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.

**DISCHARGE SITE.** The immediate area surrounding the fireworks mortars used for an outdoor fireworks display.

**DISPLAY SITE.** The immediate area where a fireworks display is conducted. The display area includes the discharge site, the fallout area, and the required separation distance from the mortars to spectator viewing areas. The display area does not include spectator viewing areas or vehicle parking areas.

**EXPLOSIVE.** A chemical compound, mixture or device, the primary or common purpose of which is to function by explosion. The term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, igniters and display fireworks, 1.3G (Class B, Special).

The term “explosive” includes any material determined to be within the scope of any approved Saudi standards and specifications and also includes any material classified as an explosive other than consumer fireworks, 1.4G (Class C, Common) by the hazardous materials regulations of MOI or DOTn 49 CFR.

**High explosive.** Explosive material, such as dynamite, which can be caused to detonate by means of a No. 8 test blasting cap when unconfined.

**Low explosive.** Explosive material that will burn or deflagrate when ignited. It is characterized by a rate of reaction that is less than the speed of sound. Examples of low explosives include, but are not limited to, black powder, safety fuse, igniters, igniter cord, fuse lighters, fireworks, 1.3G (Class B special) and propellants, 1.3C.

**Mass-detonating explosives.** Divisions 1.1, 1.2 and 1.5 explosives alone or in combination, or loaded into various types of ammunition or containers, most of which can be expected to explode virtually instantaneously when a small portion is subjected to fire, severe concussion, impact, the impulse of an initiating agent, or the effect of a considerable discharge of energy from without. Materials that react in this manner represent a mass explosion hazard.

Such an explosive will normally cause severe structural damage to adjacent objects. Explosive propagation could occur immediately to other items of ammunition and explosives stored sufficiently close to and not adequately protected from the initially exploding pile with a time interval short enough so that two or more quantities must be considered as one for quantity-distance purposes.

**MOI or (US/DOTn) Class 1 explosives.** The following terms further define explosives under the system applied by MOI or (DOTn) for all explosive materials defined as hazard Class 1 materials. Compatibility group letters are used in concert with the Division to specify further limitations on each division noted, (i.e., the letter G identifies the material as a pyrotechnic substance or article containing a pyrotechnic substance and similar materials).

**Division 1.1.** Explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.

**Division 1.2.** Explosives that have a projection hazard but not a mass explosion hazard.

**Division 1.3.** Explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

**Division 1.4.** Explosives that pose a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.

**Division 1.5.** Very insensitive explosives. This division is comprised of substances that have a mass explosion hazard but which are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

**Division 1.6.** Extremely insensitive articles which do not have a mass explosion hazard. This division is comprised of articles that contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

**EXPLOSIVE MATERIAL.** The term “explosive” material means explosives, blasting agents, and detonators.

**FALLOUT AREA.** The area over which aerial shells are fired. The shells burst over the area, and unsafe debris and malfunctioning aerial shells fall into this area. The fallout area is the location where a typical aerial shell dud falls to the ground depending on the wind and the angle or mortar placement.

**FIREWORKS.** Any composition or device for the purpose of producing a visible or an audible effect for entertainment purposes by combustion, deflagration or detonation that meets the definition of 1.4G fireworks or 1.3G fireworks as set forth herein.

**Fireworks, 1.4G.** (Formerly known as Class C, Common Fireworks) Small fireworks devices containing restricted amounts of pyrotechnic composition designed primarily to produce visible or audible effects by combustion. Such 1.4G fireworks which comply with the construction, chemical composition and labeling regulations of the MOI or (DOTn) for Fireworks (UN 0336, and the U.S. Consumer Product Safety Commission as set forth in CPSC 16 CFR: Parts 1500 and 1507), are not explosive materials for the purpose of this code requirements.

**Fireworks, 1.3G.** (Formerly Class B, Special Fireworks.) Large fireworks devices, which are explosive materials, intended for use in fireworks displays and designed to produce audible or visible effects by combustion, deflagration or detonation. Such 1.3G fireworks include, but are not limited to, firecrackers containing more than 130 mg of explosive composition, aerial shells containing more than 40 grams of pyrotechnic composition, and other display pieces which exceed the limits for classification as 1.4G fireworks. Such 1.3G fireworks, are also described as Fireworks, by the MOI or UN0335 by the DOTn.

**FIREWORKS DISPLAY.** A presentation of fireworks for a public or private gathering.

**HIGHWAY.** A public street, public alley or public road.

**INHABITED BUILDING.** A building regularly occupied in whole or in part as a habitation for human beings, or any Mosques, schoolhouse, railroad station, store or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the manufacture, transportation, storage or use of explosive materials.

**MAGAZINE.** A building, structure or container, other than an operating building, approved for storage of explosive materials.

**Indoor.** A portable structure, such as a box, bin or other container, constructed as required for Type 2, 4 or 5 magazines in accordance with NFPA 495, NFPA 1124 or MOI or DOTy 27 CFR Part 55 so as to be fire resistant and theft resistant.

**Type 1.** A permanent structure, such as a building or igloo, that is bullet resistant, fire resistant, theft resistant, weather resistant and ventilated in accordance with the requirements of NFPA 495, NFPA 1124, or MOI or DOTy 27 CFR Part 55.

**Type 2.** A portable or mobile structure, such as a box, skid-magazine, trailer or semitrailer, constructed in accordance with the requirements of NFPA 495, NFPA 1124 or MOI or DOTy 27 CFR, Part 55 that is fire resistant, theft resistant, weather resistant and ventilated. If used outdoors, a Type 2 magazine is also bullet resistant.

**Type 3.** A fire-resistant, theft-resistant and weather-resistant “day box” or portable structure constructed in accordance with NFPA 495, NFPA 1124, or MOI or DOTy 27 CFR Part 55 used for the temporary storage of explosive materials.

**Type 4.** A permanent, portable or mobile structure such as a building, igloo, box, semitrailer or other mobile container that is fire resistant, theft resistant and weather resistant and constructed in accordance with NFPA 495, NFPA 1124, or MOI or DOTy 27 CFR Part 55.

**Type 5.** A permanent, portable or mobile structure such as a building, igloo, box, bin, tank, semitrailer, bulk trailer, tank trailer, bulk truck, tank truck or other mobile container that is theft resistant, which is constructed in accordance with NFPA 495, NFPA 1124, or MOI or DOTy 27 CFR Part 55.

**MORTAR.** A tube from which fireworks shells are fired into the air.

**NET EXPLOSIVE WEIGHT (net weight).** The weight of explosive material expressed in pounds. The net explosive weight is the aggregate amount of explosive

material contained within buildings, magazines, structures or portions thereof, used to establish quantity-distance relationships.

**OPERATING BUILDING.** A building occupied in conjunction with the manufacture, transportation, storage, or use of explosive materials. Operating buildings are separated from one another with the use of intraplant or intraline distances.

**PLOSOPHORIC MATERIAL.** Two or more unmixed, commercially manufactured, prepackaged chemical substances including oxidizers, flammable liquids or solids, or similar substances that are not independently classified as explosives but which, when mixed or combined, form an explosive that is intended for blasting.

**PROXIMATE AUDIENCE.** An audience closer to pyrotechnic devices than permitted by NFPA 1123.

**PYROTECHNIC COMPOSITION.** A chemical mixture that produces visible light displays or sounds through a self-propagating, heat-releasing chemical reaction which is initiated by ignition.

**PYROTECHNIC SPECIAL EFFECT.** A visible or audible effect for entertainment created through the use of pyrotechnic materials and devices.

**PYROTECHNIC SPECIAL-EFFECT MATERIAL.** A chemical mixture used in the entertainment industry, to produce visible or audible effects by combustion, deflagration or detonation. Such a chemical mixture predominantly consists of solids capable of producing a controlled, self-sustaining and self-contained exothermic chemical reaction that results in heat, gas sound, light or a combination of these effects. The chemical reaction functions without external oxygen.

**RAILWAY.** A steam, electric or other railroad or railway that carries passengers for hire.

**READY BOX.** A weather-resistant container with a self-closing or automatic-closing cover that protects fireworks shells from burning debris. Tarpaulins shall not be considered as ready boxes.

**SMALL ARMS AMMUNITION.** A shotgun, rifle or pistol cartridge and any cartridge for propellant-actuated devices. This definition does not include military ammunition containing bursting charges or incendiary, trace, spotting or pyrotechnic projectiles.

**SMALL ARMS PRIMERS.** Small percussion-sensitive explosive charges, encased in a cap, used to ignite propellant powder.

**SMOKELESS PROPELLANTS.** Solid propellants, commonly referred to as smokeless powders, used in small arms ammunition, cannons, rockets, propellant-actuated devices and similar articles.

**SPECIAL INDUSTRIAL EXPLOSIVE DEVICE.** An explosive power pack



containing an explosive charge in the form of a cartridge or construction device. The term includes but is not limited to explosive rivets, explosive bolts, explosive charges for driving pins or studs, cartridges for explosive-actuated power tools and charges of explosives used in automotive air bag inflators, jet tapping of open hearth furnaces and jet perforation of oil well casings.

**THEFT RESISTANT.** Construction designed to deter illegal entry into facilities for the storage of explosive materials.

### SECTION 31.3 RECORD KEEPING AND REPORTING

- 31.3.1 General.** Records of the receipt, handling, use or disposal of explosive materials, and reports of any accidents, thefts, or unauthorized activities involving explosive materials shall conform to the requirements of this section.
- 31.3.2 Transaction record.** The permittee shall maintain a record of all transactions involving receipt, removal, use or disposal of explosive materials. Such a record shall be maintained for a period of 5 years, and shall be furnished to the building code official for inspection upon request.  
**Exception:** Where only Division 1.4G (consumer fireworks) are handled, records need only be maintained for a period of 3 years.
- 31.3.3 Loss, theft or unauthorized removal.** The loss, theft or unauthorized removal of explosive materials from a magazine or permitted facility shall be reported to the building code official, and the local law enforcement authorities within 24 hours.
- 31.3.4 Accidents.** Accidents involving the use of explosives, explosive materials and fireworks, which result in injuries or property damage, shall be reported to the building code official immediately.
- 31.3.5 Misfires.** The pyrotechnic display operator or blaster in charge shall keep a record of all aerial shells that fail to fire or charges that fail to detonate.
- 31.3.6 Hazard communication.** Manufacturers of explosive materials and fireworks shall maintain records of chemicals, chemical compounds and mixtures required by MOI or DOL 29 CFR, Part 1910.1200, and Section 5B7.
- 31.3.7 Safety rules.** Current safety rules covering the operation of magazines, as described in Section 31.4.7, shall be posted on the interior of the magazine in a visible location.

### SECTION 31.4 EXPLOSIVE MATERIALS STORAGE AND HANDLING

- 31.4.1 General.** Storage of explosives and explosive materials, small arms ammunition, small arms primers, propellant-actuated cartridges and smokeless propellants in magazines, shall conform to the provisions of this section.
- 31.4.2 Magazine required.** Explosives and explosive materials, and Division 1.3G fireworks shall be stored in magazines constructed, located, operated and maintained in accordance with the provisions of Section 31.4 and NFPA 495 or

NFPA 1124.

**Exceptions:**

1. Storage of fireworks at display sites in accordance with Section 31.8.5 and NFPA 1123 or NFPA 1126.
2. Portable or mobile magazines not exceeding 11 m<sup>2</sup> in area shall not be required to comply with the requirements of this code.

**31.4.3 Magazines.** The storage of explosives and explosive materials in magazines shall comply with Table 31.4.3.

**31.4.3.1 High explosives.** Explosive materials classified as Division 1.1 or 1.2 shall be stored in Type 1, 2 or 3 magazines.

**Exceptions:**

1. Black powder shall be stored in a Type 1, 2, 3 or 4 magazines.
2. Cap-sensitive explosive material that is demonstrated not to be bullet sensitive shall be stored in a Type 1, 2, 3, 4 or 5 magazine.

**31.4.3.2 Low explosives.** Explosive materials that are not cap sensitive shall be stored in a Type 1, 2, 3, 4 or 5 magazines.

**31.4.3.3 Detonating cord.** For quantity and distance purposes, detonating cord of 3 grams per 0.3 m shall be calculated as equivalent to 4 kg of high explosives per 305 m. Heavier or lighter core loads shall be rated proportionally.

**TABLE 31.4.3  
STORAGE AMOUNTS AND MAGAZINE REQUIREMENTS FOR EXPLOSIVES,  
EXPLOSIVE MATERIALS AND FIREWORKS, 1.3G MAXIMUM ALLOWABLE  
QUANTITY PER CONTROL AREA**

(UN/DOTh) DIVISION	INDOOR <sup>a</sup> (kg)				OUTDOOR (kg)	MAGAZINE TYPE REQUIRED				
	Unprotected	Cabinet	Sprinklers	Sprinklers & cabinet		1	2	3	4	5
1.1 <sup>b</sup>	0	0	0.45	0.9	0.45	X	X	X	–	–
1.2	0	0	0.45	0.9	0.45	X	X	X	–	–
1.2	0	0	0.45	0.9	0.45	X	X	X	X	–
1.3	0	0	2.3	4.5	0.45	X	X	X	X	–
1.4	0	0	23	45	0.45	X	X	X	X	–
1.5	0	0	0.45	0.9	0.45	X	X	X	X	–
1.5	0	0	0.45	0.9	0.45	X	X	X	X	X
1.6	0	0	0.45	0.9	0.45	X	X	X	X	X

- a. A factor of 1.2 kg per liter shall be used for converting kilograms (solid) to liters (liquid) in accordance with Section 25.3.1.2.
- b. Black powder shall be stored in a Type 1, 2, 3 or 4 magazines as provided for in Section 31.4.3.1.

**31.4.4 Prohibited storage.** Detonators shall be stored in a separate magazine for blasting supplies and shall not be stored in a magazine with other explosive materials.

**31.4.5 Location.** The use of magazines for storage of explosives and explosive materials shall comply with Sections 31.4.5.1 through 31.4.5.3.3.

**31.4.5.1 Indoor magazines.** The use of indoor magazines for storage of explosives and explosive materials shall comply with the requirements of this section.

**31.4.5.1.1 Use.** The use of indoor magazines for storage of explosives and explosive materials shall be limited to occupancies of Group F, H, M or S, and research and development laboratories.

- 31.4.5.1.2 Construction.** Indoor magazines shall comply with the following construction requirements:
1. Construction shall be fire resistant and theft resistant.
  2. Exterior shall be painted red.
  3. Base shall be fitted with wheels, casters or rollers to facilitate removal from the building in an emergency.
  4. Lid or door shall be marked with conspicuous white lettering not less than 76 mm high and minimum 12.7 mm stroke, reading EXPLOSIVES — KEEP FIRE AWAY.
  5. The least horizontal dimension shall not exceed the clear width of the entrance door.
- 31.4.5.1.3 Quantity limit.** Not more than 23 kg of explosives or explosive materials shall be stored within an indoor magazine.
- 31.4.5.1.4 Prohibited use.** Indoor magazines shall not be used within buildings containing Group R occupancies.
- 31.4.5.1.5 Location.** Indoor magazines shall be located within 3.1 m of an entrance and only on floors at or having ramp access to the exterior grade level.
- 31.4.5.1.6 Number.** Not more than two indoor magazines shall be located in the same building. Where two such magazines are located in the same building, one magazine shall be used solely for the storage of not more than 5,000 detonators.
- 31.4.5.1.7 Separation distance.** When two magazines are located in the same building, they shall be separated by a distance of not less than 3.1 m.
- 31.4.5.2 Outdoor magazines.** All outdoor magazines other than Type 3 shall be located so as to comply with Table 31.4.5.2(2), Table 31.4.5.2(3) or Table 31.4.5.2(4) as set forth in Table 31.4.5.2(1).
- 31.4.5.3 Special requirements for Type 3 magazines.** Type 3 magazines shall comply with Sections 31.4.5.3.1 through 31.4.5.3.3.
- 31.4.5.3.1 Location.** Wherever practicable, Type 3 magazines shall be located away from neighboring inhabited buildings, railways, highways, and other magazines in accordance with Table 31.4.5.2(2), 31.4.5.2(3) or 31.4.5.2(4) as applicable.
- 31.4.5.3.2 Supervision.** Type 3 magazines shall be attended when explosive materials are stored within. Explosive materials shall be removed to appropriate storage magazines for unattended storage at the end of the work day.
- 31.4.5.3.3 Use.** Not more than two Type 3 magazines shall be located at the same blasting site. Where two Type 3 magazines are located at the same blasting site, one magazine shall be used solely for the storage of detonators.
- 31.4.6 Construction.** Magazines shall be constructed in accordance with Sections 31.4.6.1 through 31.4.6.5.2.
- 31.4.6.1 Drainage.** The ground around a magazine shall be graded so that water drains away from the magazine.
- 31.4.6.2 Heating.** Magazines requiring heat shall be heated as prescribed in NFPA 495 by either hot water radiant heating within the magazine or by indirect warm air heating.
- 31.4.6.3 Lighting.** When lighting is necessary within a magazine, electric safety flashlights or electric safety lanterns shall be used, except as provided in NFPA 495.

**TABLE 31.4.5.2(1)**  
**APPLICATION OF SEPARATION DISTANCE TABLE<sup>a</sup>**

<b>DOTn DIVISION</b>	<b>TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVE MATERIALS 31.4.5.2(2) (MOI .....(DOTy 27 CFR, Part 55.218))</b>	<b>TABLE OF SEPARATION DISTANCES FOR LOW EXPLOSIVES 31.4.5.2(3) DOTy 27 CFR, Part 55.219</b>	<b>TABLE OF DISTANCES FOR BUILDINGS CONTAINING EXPLOSIVES DIVISION 1.4 31.4.5.2(4)</b>
1.1	X	–	–
1.2	X	–	–
1.3	–	X	–
1.4G or 1.4S fireworks	–	–	X
1.4B or 1.4S detonators	–	–	X
1.5	X	–	–
1.6	Not Applicable	Not Applicable	Not Applicable

- a. Where adjacent magazines contain different classes of explosive materials, the separation between magazine shall be as prescribed by Table 31.4.5.

**TABLE 31.4.5.2(2)**  
**TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES AS APPROVED BY THE (INSTITUTE OF MAKERS OF**  
**EXPLOSIVES AND REVISED JUNE 1991)<sup>a</sup>**

DISTANCES IN METERS											
QUANTITY OF EXPLOSIVE MATERIALS <sup>c</sup>		Inhabited buildings		Public highways with traffic volume less than 3,000 vehicles per day		Public highways with traffic volume greater than 3,000 vehicles per day and passenger railways		Separation of magazines <sup>d</sup>			
Kgs over	Kgs not over	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded		
0	2.3	21.3	43	9.2	18.3	15.5	31	1.8	3.7		
2.3	4.5	27.5	55	10.7	21.3	19.5	39	2.4	4.9		
4.5	9	33.5	67	13.7	27.5	24.7	49	3	6		
9	13.5	38	76	15.3	30.5	28.4	57	3.4	6.7		
13.5	18	43	85	16.7	33.5	31.5	63	3.7	7.3		
18	23	46	91	18.3	36.5	33.5	67	4.3	8.5		
23	34	52	104	21.3	43	39	77	4.6	9.2		
34	45	58	116	23	46	42	85	4.9	9.8		
45	57	61	122	24.4	49	46	91	5.5	11		
57	68	66	131	26	52	48.5	97	5.8	11.6		
68	91	72	143	29	58	53	107	6.4	12.8		
91	114	78	155	32	64	58	115	7	14		
114	136	82	165	33.5	67	61	123	7.3	14.6		
136	182	90	180	36.5	73	67	135	8.2	16.5		
182	227	98	195	40	79	73	145	8.8	17.7		
227	272	104	207	41	82	77	154	9.5	19		
272	318	108	216	44	88	81	162	9.8	19.5		
318	363	114	229	46	91	85	169	10	20		
363	409	119	238	47	94	88	176	10.7	21.3		
409	454	122	244	49	98	91	183	11	22		
454	545	130	259	50	101	97	194	12	23.8		
545	636	137	274	52	104	102	205	12.5	25		
636	726	143	287	53	107	107	214	13	26		
726	817	150	299	55	110	112	223	13.5	27		
817	908	154	308	56	113	115	230	13.7	27.5		

(continued)

TABLE 31.4.5.2(2)—continued	
TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES AS APPROVED BY THE (INSTITUTE OF MAKERS OF EXPLOSIVES AND REVISED JUNE 1991) <sup>a</sup>	
	DISTANCES IN METERS

DISTANCES IN METERS									
QUANTITY OF EXPLOSIVE MATERIALS <sup>c</sup>		Inhabited buildings		Public highways with traffic volume less than 3,000 vehicles per day		Public highways with traffic volume greater than 3,000 vehicles per day and passenger railways		Separation of magazines <sup>d</sup>	
		Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
908	1,135	166	332	58	116	124	249	15	30
1,135	1,362	177	354	59	119	132	263	15.8	32
1,362	1,816	194	387	64	128	144	289	17.7	35.5
1,816	2,270	209	418	69	137	156	313	18.6	37
2,270	2,724	223	445	72	143	166	333	20	40
2,724	3,178	235	469	75	149	175	349	20.7	41.5
3,178	3,632	244	488	76	152	183	366	22	44
3,632	4,086	255	509	78	155	190	380	23	46
4,086	4,540	264	527	79	158	197	393	23.8	47.5
4,540	5,448	267	533	82	165	209	419	25	50
5,448	6,356	270	540	84	168	220	441	26.5	53
6,356	7,264	274	549	85	171	230	461	27.5	55
7,264	8,172	287	573	87	174	240	479	28.6	57
8,172	9,080	297	594	88	177	248	496	30	60
9,080	11,350	322	610	96	192	267	534	32	64
11,350	13,620	344	610	104	207	284	569	34	68
13,620	15,890	367	610	110	219	299	598	36	73
15,890	18,160	389	610	116	232	313	610	38	76
18,160	20,430	408	610	122	244	326	610	39	79
20,430	22,700	427	610	128	256	336	610	41	82
22,700	24,970	445	610	134	268	347	610	43	85
24,970	27,240	462	610	139	277	358	610	44	88
27,240	29,510	477	610	143	287	368	610	46	91
29,510	31,780	491	610	148	296	377	610	47	94
31,780	34,050	504	610	152	305	385	610	49	98

**TABLE 31.4.5.2(2)—continued**  
**TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES AS APPROVED BY THE (INSTITUTE OF MAKERS OF EXPLOSIVES AND REVISED JUNE 1991)<sup>a</sup>**  
**DISTANCES IN METERS**

QUANTITY OF EXPLOSIVE MATERIALS <sup>c</sup>		Inhabited buildings		Public highways with traffic volume less than 3,000 vehicles per day		Public highways with traffic volume greater than 3,000 vehicles per day and passenger railways		Separation of magazines <sup>d</sup>	
		Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded	Barricaded	Unbarricaded
Kgs over	Kgs not over								
34,050	36,320		610	155	311	394	610	50	101
36,320	38,590		610	158	317	401	610	52	104
38,590	40,860		610	162	323	410	610	53	107
40,860	43,130		610	165	329	417	610	55	110
43,130	45,400		610	166	332	424	610	56	113
45,400	49,940		610	168	335	438	610	59	119
49,940	54,480		610	169	338	451	610	62	125
54,480	59,020		610	171	341	464	610	66	131
59,020	63,560		610	172	344	475	610	69	137
63,560	68,100		610	174	347	486	610	72	143
68,100	72,640		610	177	354	497	610	75	149
72,640	77,180		610	180	360	507	610	78	155
77,180	81,720		610	183	366	517	610	81	162
81,720	86,260		613	184	369	526	610	84	168
86,260	90,800		619	186	372	535	610	87	174
90,800	95,340		626	189	378	543	610	90	180
95,340	104,420		640	194	387	560	610	96	192
104,420	113,500		657	198	396	576	610	102	204
113,500	124,850		675	204	408	594	610	110	219
124,850	136,200 <sup>b</sup>		693	210	421	610	610	117	235

- a. This table applies only to the manufacture and permanent storage of commercial explosive materials. It is not applicable to transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles or other heavily encased explosives.
- b. Storage in excess of 136,200 kg of explosive materials in one magazine is not allowed.
- c. Where a manufacturing building on an explosive materials plant site is designed to contain explosive materials, such building shall be located with respect to its proximity to inhabited buildings, public highways and passenger railways based on the maximum quantity of explosive materials permitted to be in the building at one time.
- d. Where two or more storage magazines are located on the same property, each magazine shall comply with the minimum distances specified from inhabited buildings, railways and highways, and, in addition, they should be separated from each other by not less than the distances shown for separation of magazines, except that the quantity of explosives in detonator magazines shall govern in regard to the spacing of said detonator magazines from magazines containing other explosive materials. Where any two or more magazines are separated from each other by less than the specified separation of magazines distances, then two or more such magazines, as a group, shall be considered as one magazine, and the total quantity of explosive materials stored in such group shall be treated as if stored in a single magazine located on the site of any magazine in the group and shall comply with the minimum distances specified from other magazines, inhabited buildings, railways and highways.

**TABLE 31.4.5.2(3)**  
**TABLE OF DISTANCES FOR BUILDINGS CONTAINING**  
**EXPLOSIVES – DIVISION 1.3 – MASS-FIRE HAZARD<sup>a, b, c</sup>**

QUANTITY OF DIVISION 1.3 EXPLOSIVES		DISTANCES IN METERS		
Kgs over	Kgs not over	Inhabited buildings	Passenger railways and public highways	Magazines and operating buildings
0	454	23	23	15.3
454	2,270	35	35	23
2,270	4,540	46	46	30.5
4,540	9,080	58	58	38
9,080	13,620	66	66	44
13,620	18,160	72	72	47
18,160	22,700	76	76	50
22,700	27,240	79	79	53
27,240	31,780	82	82	56
31,780	36,320	85	85	58
36,320	40,560	90	90	60
40,860	45,400	91	91	61
45,400	90,800	114	114	76
90,800	136,200	137	137	91

- Black powder, when stored in magazines, is defined as low explosive by the MOI.
- For quantities less than 454 kilograms, the required distances are those specified for 454 kilograms. The use of lesser distances is permitted when supported by approved test data and/or analysis.
- Linear interpolation of explosive quantities between table entries is permitted.

**TABLE 31.4.5.2(4)**  
**TABLE OF DISTANCES FOR BUILDINGS CONTAINING**  
**EXPLOSIVES - DIVISION 1.4<sup>c</sup>**

QUANTITY OF DIVISION 1.3 EXPLOSIVES		DISTANCES IN METERS		
Kgs over	Kgs not over	From Inhabited Buildings	From Public Railroad and Highway	From Above-ground Magazine and Operating Buildings <sup>a,b</sup>
23	Not Limited	30.5	30.5	15.3

- A separation distance of 30.5 meters is required for buildings of other than Type I or Type II construction as defined in the SBC 201.
- For earth-covered magazines, no specified separation is required.
  - Earth cover material used for magazines shall be relatively cohesive. Solid or wet clay and similar types of soil are to cohesive and shall not be used. Soil shall be free from unsanitary organic matter, trash, debris and stones heavier than 4.5 kg or larger than 152 mm in diameter. Compaction and surface preparation shall be provided, as necessary, to maintain structural integrity and avoid erosion. Where cohesive material cannot be used, as in sandy soil, the earth cover over magazines shall be finished with a suitable material to ensure structural integrity.
  - The earth fill or earth cover between earth-covered magazines shall be either solid or sloped, in accordance with the requirements of other construction features, but a minimum of 0.6 m of earth cover shall be maintained over the top of each magazines. To reduce erosion and facilitate maintenance operations, the cover shall have a slope of 2 horizontal to 1 vertical.
- Restricted to articles, including articles packaged for shipment, that are not regulated as an explosive under (Bureau of Alcohol, Tobacco and Firearms (BATF)) regulations, or unpacked articles used in process operations that do not propagate a detonation of deflagration between articles.

**31.4.6.4 Nonsparking materials.** In other than Type 5 magazines, there shall be no exposed ferrous metal on the interior of a magazine containing packages of explosives.



**31.4.6.5 Signs and placards.** Property upon which Type 1 magazines and outdoor magazines of Types 2, 4 and 5 are located shall be posted with signs stating: EXPLOSIVES — KEEP OFF. These signs shall be of contrasting colors with a minimum letter height of 76 mm with a minimum brush stroke of 13 mm. The signs shall be located to minimize the possibility of a bullet shot at the sign hitting the magazine.

**31.4.6.5.1 Access road signs.** At the entrance to explosive material manufacturing and storage sites, all access roads shall be posted with the following warning sign or other approved sign:

**DANGER!**  
**NEVER FIGHT EXPLOSIVE FIRES.**  
**EXPLOSIVES ARE STORED ON THIS SITE**  
**CALL \_\_\_\_\_.**

The sign shall be weather resistant with a reflective surface and have lettering at least 50 mm high.

**31.4.6.5.2 Placards.** Type 5 magazines containing Division 1.5 blasting agents shall be prominently placarded as required during transportation by MOI or DOTn 49 CFR, Part 172 and DOTn 27 CFR, Part 55.

**31.4.7 Operation.** Magazines shall be operated in accordance with Sections 31.4.7.1 through 31.4.7.9.

**31.4.7.1 Security.** Magazines shall be kept locked in the manner prescribed in NFPA 495 at all times except during placement or removal of explosives or inspection.

**31.4.7.2 Open flames and lights.** Smoking, matches, flame-producing devices, open flames, firearms and firearms cartridges shall not be permitted inside of or within 15.3 m of magazines.

**31.4.7.3 Brush.** The area located around a magazine shall be kept clear of brush, dried grass, leaves, trash, debris, and similar combustible materials for a distance of 7.6 m.

**31.4.7.4 Combustible storage.** Combustible materials shall not be stored within 15.3 m of magazines.

**31.4.7.5 Unpacking and repacking explosive materials.** Containers of explosive materials, except fiberboard containers, and packages of damaged or deteriorated explosive materials or fireworks shall not be unpacked or repacked inside or within 15.3 m of a magazine or in close proximity to other explosive materials.

**31.4.7.5.1 Storage of opened packages.** Packages of explosive materials that have been opened shall be closed before being placed in a magazine.

**31.4.7.5.2 Nonsparking tools.** Tools used for the opening and closing of packages of explosive materials, other than metal slitters for opening paper, plastic or fiber-board containers, shall be made of nonsparking materials.

**31.4.7.5.3 Disposal of packaging.** Empty containers and paper and fiber packaging materials that previously contained explosive materials shall be disposed of or re-used in a approved manner.

**31.4.7.6 Tools and equipment.** Metal tools, other than nonferrous transfer conveyors and ferrous metal conveyor stands protected by a coat of paint, shall not be stored in a magazine containing explosive materials or detonators.

**31.4.7.7 Contents.** Magazines shall be used exclusively for the storage of explosive materials, blasting materials and blasting accessories.

**31.4.7.8 Compatibility.** Corresponding grades and brands of explosive materials shall be stored together and in such a manner that the grade and brand marks are visible. Stocks shall be stored so as to be easily counted and checked. Packages of explosive materials shall be stacked in a stable manner not exceeding 8 feet 2.4 m in height.

- 31.4.7.9 Stock rotation.** When explosive material is removed from a magazine for use, the oldest usable stocks shall be removed first.
- 31.4.8 Maintenance.** Maintenance of magazines shall comply with Sections 31.4.8.1 through 31.4.8.3.
- 31.4.8.1 Housekeeping.** Magazine floors shall be regularly swept and be kept clean, dry and free of grit, paper, empty packages and rubbish. Brooms and other cleaning utensils shall not have any spark-producing metal parts. Sweepings from magazine floors shall be disposed of in accordance with the manufacturers' approved instructions.
- 31.4.8.2 Repairs.** Explosive materials shall be removed from the magazine before making repairs to the interior of a magazine. Explosive materials shall be removed from the magazine before making repairs to the exterior of the magazine where there is a possibility of causing a fire. Explosive materials removed from a magazine under repair shall either be placed in another magazine or placed a safe distance from the magazine, where they shall be properly guarded and protected until repairs have been completed. Upon completion of repairs, the explosive materials shall be promptly returned to the magazine. Floors shall be cleaned before and after repairs.
- 31.4.8.3 Floors.** Magazine floors stained with liquid shall be dealt with according to instructions obtained from the manufacturer of the explosive material stored in the magazine.
- 31.4.9 Inspection.** Magazines containing explosive materials shall be opened and inspected at maximum 7-day intervals. The inspection shall determine whether there has been an unauthorized or attempted entry into a magazine or an unauthorized removal of a magazine or its contents.
- 31.4.10 Disposal of explosive materials.** Explosive materials shall be disposed of in accordance with Sections 31.4.10.1 through 31.4.10.7.
- 31.4.10.1 Notification.** The building code official shall be notified immediately when deteriorated or leaking explosive materials are determined to be dangerous or unstable and in need of disposal.
- 31.4.10.2 Deteriorated materials.** When an explosive material has deteriorated to an extent that it is in an unstable or dangerous condition, or when a liquid has leaked from an explosive material, the person in possession of such material shall immediately contact the material's manufacturer to obtain disposal and handling instructions.
- 31.4.10.3 Qualified person.** The work of destroying explosive materials shall be directed by persons experienced in the destruction of explosive materials.
- 31.4.10.4 Storage of misfires.** Explosive materials and fireworks recovered from blasting or display misfires shall be placed in a magazine until an experienced person has determined the proper method for disposal.
- 31.4.10.5 Disposal sites.** Sites for the destruction of explosive materials and fireworks shall be approved and located at the maximum practicable safe distance from inhabited buildings, public highways, operating buildings, and all other exposures to ensure keeping air blast and ground vibration to a minimum. The location of disposal sites shall be no closer to magazines, inhabited buildings, railways, highways and other rights-of-way than is permitted by Tables 31.4.5.2(1), 31.4.5.2(2) and 31.4.5.2(3). When possible, barricades shall be utilized between the destruction site and inhabited buildings. Areas where explosives are detonated or burned shall be posted with adequate warning signs.
- 31.4.10.6 Reuse of site.** Unless an approved burning site has been thoroughly saturated with water and has passed a safety inspection, 48 hours shall elapse between the

completion of a burn and the placement of scrap explosive materials for a subsequent burn.

- 31.4.10.7 Personnel safeguards.** Once an explosive burn operation has been started, personnel shall relocate to a safe location where adequate protection from air blast and flying debris is provided. Personnel shall not return to the burn area until the person in charge has inspected the burn site and determined that it is safe for personnel to return.

## **SECTION 31.5**

### **MANUFACTURE, ASSEMBLY AND TESTING OF EXPLOSIVES, EXPLOSIVE MATERIALS AND FIREWORKS**

- 31.5.1 General.** The manufacture, assembly and testing of explosives, ammunition, blasting agents and fireworks shall comply with the requirements of this section and NFPA 495 or NFPA 1124.

**Exceptions:**

1. The hand loading of small arms ammunition prepared for personal use and not offered for resale.
2. The mixing and loading of blasting agents at blasting sites in accordance with NFPA 495.
3. The use of binary explosives or phosphoric materials in blasting or pyrotechnic special effects applications in accordance with NFPA 495 or NFPA 1126.

- 31.5.2 Emergency planning and preparedness.** Emergency plans, emergency drills, employee training and hazard communication shall conform to the provisions of this section and Sections 5b.4 through 5b.7.

- 31.5.2.1 Hazardous Materials Management Plans and Inventory Statements required.** Detailed Hazardous Materials Management Plans (HMMP) and Hazardous Materials Inventory Statements (HMIS) complying with the requirements of Section 5b.7 shall be prepared and submitted to the local emergency planning committee, the building code official, and the local Civil Defence.

- 31.5.2.2 Maintenance of plans.** A copy of the required HMMP and HMIS shall be maintained on-site and furnished to the building code official on request.

- 31.5.2.3 Employee training.** Workers who handle explosives or explosive charges or dispose of explosives shall be trained in the hazards of the materials and processes in which they are to be engaged and with the safety rules governing such materials and processes.

- 31.5.2.4 Emergency procedures.** Approved emergency procedures shall be formulated for each plant which will include personal instruction in any emergency that may be anticipated. All personnel shall be made aware of an emergency warning signal.

- 31.5.3 Intraplant separation of operating buildings.** Explosives and fireworks manufacturing buildings, including those where explosive charges are assembled, manufactured, prepared or loaded utilizing Division 1.1, 1.2, 1.3, 1.4 or 1.5 explosives, shall be separated from all other buildings, including magazines, within the confines of the manufacturing plant at a distance not less than those shown in Table 31.5.3, 31.4.5.2 (3), or Table 31.4.5.2 (4), as appropriate.

The quantity of explosives in an operating building shall be the net weight of all explosives contained therein. Distances shall be based on the hazard division requiring the greatest separation, unless the aggregate explosive weight is divided by approved walls or shields designed for that purpose. When dividing a quantity of explosives into smaller stacks, a suitable barrier or adequate separation distance

shall be provided to prevent propagation from one stack to another.

When distance is used as the sole means of separation within a building, such distance shall be established by testing. Testing shall demonstrate that propagation between stacks will not result. Barriers provided to protect against explosive effects shall be designed and installed in accordance with approved standards.

**Exception:** Fireworks-manufacturing buildings separated in accordance with NFPA 1124.

**TABLE 31.5.3**  
**MINIMUM INTRAPLANT SEPARATION DISTANCES BETWEEN BARRICADED**  
**OPERATING BUILDINGS CONTAINING**  
**EXPLOSIVES—DIVISION 1.1, 1.2 OR 1.5—MASS EXPLOSION HAZARD<sup>a</sup>**

EXPLOSIVES			EXPLOSIVES		
Kgs over	Kgs not over	Minimum distance (meters)	Kgs over	Kgs not over	Minimum distance (meters)
0	23	9.2	9,080	11,350	81
23	45	12.2	11,350	13,620	85
45	91	15.3	13,620	15,890	90
91	136	18.3	15,890	18,160	95
136	182	20	18,160	20,430	98
182	227	21.3	20,430	22,700	101
227	272	23	22,700	24,970	104
272	318	24.4	24,970	27,240	107
318	363	26	27,240	29,510	110
363	409	27.5	29,510	31,780	113
409	454	29	31,780	34,050	117
454	681	32	34,050	36,320	119
681	908	35	36,320	38,590	120
908	1,362	40	38,590	40,860	122
1,362	1,816	43	40,860	43,130	125
1,816	2,270	46	43,130	45,400	126
2,270	2,724	49	45,400	56,750	137
2,724	3,178	52	56,750	68,100	145
3,178	3,632	55	68,100	79,450	152
3,632	4,086	58	79,450	90,800	160
4,086	4,540	61	90,800	102,150	168
4,540	6,810	69	102,150	113,500	175
6,810	9,080	75	113,500	124,850	183
—	—	—	124,850	136,200	194

- a. Where a building or magazine containing explosives is not barricaded, the intraline distances shown in this table shall be doubled.

**31.5.4 Separation of manufacturing buildings from inhabited buildings, rights-of-way, and magazines.** When a manufacturing building on an explosive materials plant site is designed to contain explosive materials, such building shall be located away from inhabited buildings, public highways, and passenger railways in accordance with Table 31.4.5.2(2), 31.4.5.2(3) or 31.4.5.2(4) as appropriate, based

on the maximum quantity of explosive materials permitted to be in the building at one time.

**Exception:** Fireworks-manufacturing buildings constructed and operated in accordance with NFPA 1124.

**31.5.5 Buildings and equipment.** Buildings or rooms that exceed the maximum allowable quantity per control area of explosive materials shall be operated in accordance with this section and constructed in accordance with the requirements of the SBC for Group H occupancies.

**Exception:** Fireworks-manufacturing buildings constructed and operated in accordance with NFPA 1124.

**31.5.5.1 Explosives dust.** Explosives dust shall not be exhausted to the atmosphere.

**31.5.5.1.1 Wet collector.** When collecting explosives dust, a wet collector system shall be used. Wetting agents shall be compatible with the explosives. Collector systems shall be interlocked with process power supplies so that the process cannot continue without the collector systems also operating.

**31.5.5.1.2 Waste disposal and maintenance.** Explosives dust shall be removed from the collection chamber as often as necessary to prevent overloading. The entire system shall be cleaned at a frequency that will eliminate hazardous concentrations of explosives dust in pipes, tubing and ducts.

**31.5.5.2 Exhaust fans.** Squirrel cage blowers shall not be used for exhausting hazardous fumes, vapors or gases. Only nonferrous fan blades shall be used for fans located within the ductwork and through which hazardous materials are exhausted. Motors shall be located outside the duct.

**31.5.5.3 Work stations.** Work stations shall be separated by distance, barrier or other approved alternatives so that fire in one station will not ignite material in another work station. Where necessary, the operator shall be protected by a personnel shield located between the operator and the explosive device or explosive material being processed. This shield and its support shall be capable of withstanding a blast from the maximum amount of explosives allowed behind it.

**31.5.6 Operations.** Operations involving explosives shall comply with Sections 31.5.6.1 through 31.5.6.10.

**31.5.6.1 Isolation of operations.** When the type of material and processing warrants, mechanical operations involving explosives in excess of 0.45 kg shall be carried on at isolated stations or at intraplant distances, and machinery shall be controlled from remote locations behind barricades or at separations so that workers will be at a safe distance while machinery is operating.

**31.5.6.2 Static controls.** The work area where the screening, grinding, blending and other processing of static-sensitive explosives or pyrotechnic materials is done shall be provided with approved static controls.

**31.5.6.3 Approved containers.** Bulk explosives shall be kept in approved, nonsparking containers when not being used or processed. Explosives shall not be stored or transported in open containers.

**31.5.6.4 Quantity limits.** The quantity of explosives at any particular work station shall be limited to that posted on the load limit signs for the individual work station. The total quantity of explosives for multiple workstations shall not exceed that established by the intraplant distances in Table 31.5.3, 31.4.5.2(3) or 31.4.5.2(4), as appropriate.

**31.5.6.4.1 Magazines.** Magazines used for storage in processing areas shall be in accordance with the requirements of Section 31.4.5.1. All explosive materials shall be removed to appropriate storage magazines for unattended storage at the end of the work day.

The contents of indoor magazines shall be added to the quantity of explosives contained at individual workstations and the total quantity of material stored, processed or used shall be utilized to establish the intraplant separation distances indicated by Table 31.5.3, 31.4.5.2(3) or 31.4.5.2(4), as appropriate.

- 31.5.6.5 Waste disposal.** Approved receptacles with covers shall be provided for each location for disposing of waste material and debris. These waste receptacles shall be emptied and cleaned as often as necessary but not less than once each day or at the end of each shift.
- 31.5.6.6 Safety rules.** General safety rules and operating instructions governing the particular operation or process conducted at that location shall be available at each location.
- 31.5.6.7 Personnel limits.** The number of occupants in each process building and in each magazine shall not exceed the number necessary for proper conduct of production operations.
- 31.5.6.8 Pyrotechnic and explosive composition quantity limits.** Not more than 227 kg of pyrotechnic or explosive composition, including not more than 5 kg of salute powder shall be allowed at one time in any process building or area. All compositions not in current use shall be kept in covered nonferrous containers.  
**Exception:** Composition that has been loaded or pressed into tubes or other containers as consumer fireworks.
- 31.5.6.9 Posting limits.** The maximum number of occupants and maximum weight of pyrotechnic and explosive composition permitted in each process building shall be posted in a conspicuous location in each process building or magazine.
- 31.5.6.10 Heat sources.** Fireworks, explosives or explosive charges in explosive materials manufacturing, assembly or testing shall not be stored near any source of heat.  
**Exception:** Approved drying or curing operations.
- 31.5.7 Maintenance.** Maintenance and repair of explosives-manufacturing facilities and areas shall comply with Section 31.4.8.
- 31.5.8 Explosive materials testing sites.** Detonation of explosive materials or ignition of fireworks for testing purposes shall be done only in isolated areas at sites where distance, protection from missiles, shrapnel or flyrock, and other safeguards provides protection against injury to personnel or damage to property.
- 31.5.8.1 Protective clothing and equipment.** Protective clothing and equipment shall be provided to protect persons engaged in the testing, ignition or detonation of explosive materials.
- 31.5.8.2 Site security.** When tests are being conducted or explosives are being detonated, only authorized persons shall be present. Areas where explosives are regularly or frequently detonated or burned shall be approved and posted with adequate warning signs. Warning devices shall be activated before burning or detonating explosives to alert persons approaching from any direction that they are approaching a danger zone.
- 31.5.9 Waste disposal.** Disposal of explosive materials waste from manufacturing, assembly or testing operations shall be in accordance with Section 31.4.10.

## SECTION 31.6

### SMALL ARMS AMMUNITION

- 31.6.1 General.** Indoor storage and display of black powder, smokeless propellants and small arms ammunition shall comply with this section and NFPA 495.

- 31.6.2 Prohibited storage.** Small arms ammunition shall not be stored together with Division 1.1, Division 1.2 or Division 1.3 explosives unless the storage facility is suitable for the storage of explosive materials.
- 31.6.3 Packages.** Smokeless propellants shall be stored in approved shipping containers conforming to DOTn 49 CFR, Part 173.
- 31.6.3.1 Repackaging.** The bulk repackaging of smokeless propellants, black powder, and small arms primers shall not be performed in retail establishments.
- 31.6.3.2 Damaged packages.** Damaged containers shall not be repackaged.  
**Exception:** Approved repackaging of damaged containers of smokeless propellant into containers of the same type and size as the original container.
- 31.6.4 Storage in residences.** The storage of small arms ammunition shall comply with Sections 31.6.4.1 and 31.6.4.2.
- 31.6.4.1 Black powder and smokeless propellants.** Propellants for personal use in quantities not exceeding 9 kg of black powder or 9 kg of smokeless powder shall be stored in original containers in occupancies limited to Group R-3. Smokeless powder in quantities exceeding 9 kg but not exceeding 23 kg kept in a wooden box or cabinet having walls of at least 25 mm nominal thickness shall be allowed to be stored in occupancies limited to Group R-3. Quantities exceeding these amounts shall not be stored in any Group R occupancy.
- 31.6.4.2 Small arms primers.** No more than 10,000 small arms primers shall be stored in occupancies limited to Group R-3.
- 31.6.5 Display and storage in Group M occupancies.** The display and storage of small arms ammunition in Group M occupancies shall comply with this section.
- 31.6.5.1 Display.** Display of small arms ammunition in Group M occupancies shall comply with Sections 31.6.5.1.1 through 31.6.5.1.3.
- 31.6.5.1.1 Smokeless propellant.** No more than 9 kg of smokeless propellants, each in containers of 0.45 kg or less capacity, shall be displayed in Group M occupancies.
- 31.6.5.1.2 Black powder.** No more than 0.45 kg of black powder shall be displayed in Group M occupancies.
- 31.6.5.1.3 Small arms primers.** No more than 10,000 small arms primers shall be displayed in Group M occupancies.
- 31.6.5.2 Storage.** Storage of small arms ammunition shall comply with Sections 31.6.5.2.1 through 31.6.5.2.3.
- 31.6.5.2.1 Smokeless propellant.** Commercial stocks of smokeless propellants shall be stored as follows:
1. Quantities exceeding 9 kg, but not exceeding 45 kg shall be stored in portable wooden boxes having walls of at least 25 mm nominal thickness.
  2. Quantities exceeding 45 kg, but not exceeding 363 kg, shall be stored in nonportable storage cabinets having walls at least 25 mm nominal thickness. Not more than 182 kg shall be stored in any one cabinet, and cabinets shall be separated by a distance of at least 8 m or by a fire partition having a fire-resistance rating of at least 1 hour.
  3. Storage of quantities exceeding 363 kg, but not exceeding 2,270 kg in a building shall comply with all of the following:
    - 3.1 The warehouse or storage room is inaccessible to unauthorized personnel.
    - 3.2 Smokeless propellant shall be stored in nonportable storage cabinets having wood walls at least 25 mm nominal thickness and having shelves with no more than 900 mm of separation between shelves.

- 3.3 No more than 182 kg is stored in any one cabinet.
- 3.4 Cabinets shall be located against walls of the storage room or warehouse with at least 12.2 m between cabinets.
- 3.5 The minimum required separation between cabinets shall be 6.1 m provided that barricades twice the height of the cabinets are attached to the wall, midway between each cabinet. The barricades must extend a minimum of 3.1 m outward, be firmly attached to the wall, and be constructed of steel not less than 6.4 mm thick, 51 mm nominal thickness wood, brick, or concrete block.
- 3.6 Smokeless propellant shall be separated from materials classified as combustible liquids, flammable liquids, flammable solids, or oxidizing materials by a distance of 7.6 m by a fire partition having a fire-resistance rating of 1 hour.
- 3.7 The building shall be equipped throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 4. Smokeless propellants not stored according to Item 1, 2, or 3 above shall be stored in a Type 2 or 4 magazines in accordance with Section 31.4 and NFPA 495.

**31.6.5.2.2 Black powder.** Commercial stocks of black powder in quantities less than 23 kg shall be allowed to be stored in Type 2 or 4 indoor or outdoor magazines. Quantities greater than 23 kg shall be stored in outdoor Type 2 or 4 magazines. When black powder and smokeless propellants are stored together in the same magazine, the total quantity shall not exceed that permitted for black powder.

**31.6.5.2.3 Small arms primers.** Commercial stocks of small arms primers shall be stored as follows:

- 1. Quantities not to exceed 750,000 small arms primers stored in a building shall be arranged such that not more than 100,000 small arms primers are stored in any one pile and piles are at least 4.6 m apart.
- 2. Quantities exceeding 750,000 small arms primers stored in a building shall comply with all of the following:
  - 2.1 The warehouse or storage building shall not be accessible to unauthorized personnel.
  - 2.2 Small arms primers shall be stored in cabinets. No more than 200,000 small arms primers shall be stored in any one cabinet.
  - 2.3 Shelves in cabinets shall have vertical separation of at least 0.6 m.
  - 2.4 Cabinets shall be located against walls of the warehouse or storage room with at least 12.2 m between cabinets.
  - 2.5 The minimum required separation between cabinets shall be 6.1 m provided that barricades twice the height of the cabinets are attached to the wall, midway between each cabinet. The barricades shall be firmly attached to the wall, and shall be constructed of steel not less than 6.4 mm thick, 51 mm nominal thickness wood, brick, or concrete block.
  - 2.6 Small arms primers shall be separated from materials classified as combustible liquids, flammable liquids, flammable solids, or oxidizing materials by a distance of 7.6 m by a fire partition having a fire-resistance rating of 1 hour.
  - 2.7 The building shall be protected throughout with an automatic sprinkler system installed in accordance with Section 7.3.3.1.1.
- 3. Small arms primers not stored in accordance with Item 1 or 2 of this section shall be stored in a magazine meeting the requirements of Section 31.4 and NFPA 495.



## SECTION 31.7

### BLASTING

- 31.7.1 General.** Blasting operations shall be conducted only by approved, competent operators familiar with the required safety precautions and the hazards involved and in accordance with the provisions of NFPA 495.
- 31.7.2 Manufacturer's instructions.** Blasting operations shall be performed in accordance with the instructions of the manufacturer of the explosive materials being used.
- 31.7.3 Blasting in congested areas.** When blasting is done in a congested area or in close proximity to a structure, railway or highway, or any other installation, precautions shall be taken to minimize earth vibrations and air blast effects. Blasting mats or other protective means shall be used to prevent fragments from being thrown.
- 31.7.4 Restricted hours.** Surface-blasting operations shall only be conducted during daylight hours. Other blasting shall be performed during daylight hours unless otherwise approved by the building code official.
- 31.7.5 Utility notification.** Whenever blasting is being conducted in the vicinity of utility lines or rights-of-way, the blaster shall notify the appropriate representatives of the utilities at least 24 hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notices shall be confirmed with written notice.  
**Exception:** In an emergency situation, the time limit shall not apply when approved.
- 31.7.6 Electric detonator precautions.** Precautions shall be taken to prevent accidental discharge of electric detonators from currents induced by radar and radio transmitters, lightning, adjacent power lines, dust and snow storms, or other sources of extraneous electricity.
- 31.7.7 Nonelectric detonator precautions.** Precautions shall be taken to prevent accidental initiation of nonelectric detonators from stray currents induced by lightning or static electricity.
- 31.7.8 Blasting area security.** During the time that holes are being loaded or are loaded with explosive materials, blasting agents or detonators, only authorized persons engaged in drilling and loading operations or otherwise authorized to enter the site shall be allowed at the blast site. The blast site shall be guarded or barricaded and posted. Blast site security shall be maintained until after the post-blast inspection has been completed.
- 31.7.9 Drill holes.** Holes drilled for the loading of explosive charges shall made and loaded in accordance with NFPA 495.
- 31.7.10 Removal of excess explosive materials.** After loading for a blast is completed and before firing, excess explosive materials shall be removed from the area and returned to the proper storage facilities.

- 31.7.11 Initiation means.** The initiation of blasts shall be by means conforming to the provisions of NFPA 495.
- 31.7.12 Connections.** The blaster shall supervise the connecting of the blastholes and the connection of the loadline to the power source or initiation point. Connections shall be made progressively from the blasthole back to the initiation point. Blasting lead lines shall remain shunted (shorted) and shall not be connected to the blasting machine or other source of current until the blast is to be fired.
- 31.7.13 Firing control.** No blast shall be fired until the blaster has made certain that all surplus explosive materials are in a safe place in accordance with Section 31.7.10, all persons and equipment are at a safe distance or under sufficient cover, and that an adequate warning signal has been given.
- 31.7.14 Post-blast procedures.** After the blast, the following procedures shall be observed:
1. No person shall return to the blast area until allowed to do so by the blaster in charge.
  2. The blaster shall allow sufficient time for smoke and fumes to dissipate and for dust to settle before returning to or approaching the blast area.
  3. The blaster shall inspect the entire blast site for misfires before allowing other personnel to return to the blast area.
- 31.7.15 Misfires.** Where a misfire is suspected, all initiating circuits shall be traced and a search made for unexploded charges. Where a misfire is found, the blaster shall provide proper safeguards for excluding all personnel from the blast area. Misfires shall be reported to the blasting supervisor immediately. Misfires shall be handled under the direction of the person in charge of the blasting operation in accordance with NFPA 495.

## SECTION 31.8 FIREWORKS DISPLAY

- 31.8.1 General.** The display of fireworks, including proximate audience displays and pyrotechnic special effects in motion picture, television, theatrical, and group entertainment productions, shall comply with this chapter and NFPA 1123 or NFPA 1126.
- 31.8.2 Permit application.** Prior to issuing permits for fireworks display, plans for the display, inspections of the display site, and demonstrations of the display operations shall be approved.
- 31.8.2.1 Outdoor displays.** In addition to the requirements of Section 4B.3, permit applications for outdoor fireworks displays using Division 1.3G fireworks shall include a diagram of the location at which the display will be conducted, including the site from which fireworks will be discharged; the location of buildings, highways, overhead obstructions and utilities; and the lines behind which the audience will be restrained.
- 31.8.2.2 Proximate audience displays.** Where the separation distances required by Section 31.8.4 and NFPA 1123 are unavailable or cannot be secured, only proximate audience displays conducted in accordance with NFPA 1126 shall be allowed. Applications for proximate audience displays shall include plans indicating the required clearances for spectators and combustibles, crowd control measures, smoke control measures, and requirements for standby personnel and equipment

when provision of such personnel or equipment is required by the building code official.

- 31.8.3 Approved displays.** Approved displays shall include only the approved Division 1.3G, Division 1.4G, and Division 1.4S fireworks, shall be handled by an approved competent operator, and the fireworks shall be arranged, located, discharged and fired in a manner that will not pose a hazard to property or endanger any person.
- 31.8.4 Clearance.** Spectators, spectator parking areas, and dwellings, buildings or structures shall not be located within the display site.
- Exceptions:**
1. This provision shall not apply to pyrotechnic special effects and displays using Division 1.4G materials before a proximate audience in accordance with NFPA 1126.
  2. This provision shall not apply to unoccupied dwellings, buildings and structures with the approval of the building owner and the building code official.
- 31.8.5 Storage of fireworks at display site.** The storage of fireworks at the display site shall comply with the requirements of this section and NFPA 1123 or NFPA 1126.
- 31.8.5.1 Supervision and weather protection.** Beginning as soon as fireworks have been delivered to the display site, they shall not be left unattended.
- 31.8.5.2 Weather protection.** Fireworks shall be kept dry after delivery to the display site.
- 31.8.5.3 Inspection.** Shells shall be inspected by the operator or assistants after delivery to the display site. Shells having tears, leaks, broken fuses or signs of having been wet shall be set aside and shall not be fired. Aerial shells shall be checked for proper fit in mortars prior to discharge. Aerial shells that do not fit properly shall not be fired. After the display, damaged, deteriorated or dud shells shall either be returned to the supplier or destroyed in accordance with the supplier's instructions and Section 31.4.10.
- Exception:** Minor repairs to fuses shall be allowed. For electrically ignited displays, attachment of electric matches and similar tasks shall be allowed.
- 31.8.5.4 Sorting and separation.** After delivery to the display site and prior to the display, all shells shall be separated according to size and their designation as salutes.
- Exception:** For electrically fired displays, or displays where all shells are loaded into mortars prior to the show, there is no requirement for separation of shells according to size or their designation as salutes.
- 31.8.5.5 Ready boxes.** Display fireworks (Division 1.3G) that will be temporarily stored at the site during the fireworks display shall be stored in ready boxes located upwind and at least 7.6 m from the mortar placement and separated according to size and their designation as salutes.
- Exception:** For electrically fired displays, or displays where all shells are loaded into mortars prior to the show, there is no requirement for separation of shells according to size, their designation as salutes, or for the use of ready boxes.
- 31.8.6 Installation of mortars.** Mortars for firing fireworks shells shall be installed in accordance with NFPA 1123 and shall be positioned so that shells are propelled away from spectators and over the fallout area. Under no circumstances shall mortars be angled toward the spectator viewing area. Prior to placement, mortars shall be inspected for defects, such as dents, bent ends, damaged interiors and damaged plugs. Defective mortars shall not be used.

- 31.8.7 Handling.** Aerial shells shall be carried to mortars by the shell body. For the purpose of loading mortars, aerial shells shall be held by the thick portion of the fuse and carefully loaded into mortars.
- 31.8.8 Display supervision.** Whenever in the opinion of the building code official or the operator a hazardous condition exists, the fireworks display shall be discontinued immediately until such time as the dangerous situation is corrected.
- 31.8.9 Post-display inspection.** After the display, the firing crew shall conduct an inspection of the fallout area for the purpose of locating unexploded aerial shells or live components. This inspection shall be conducted before public access to the site shall be allowed. Where fireworks are displayed at night and it is not possible to inspect the site thoroughly, the operator or designated assistant shall inspect the entire site at first light.
- 31.8.10 Disposal.** Any shells found during the inspection required in Section 31.8.9 shall not be handled until at least 15 minutes have elapsed from the time the shells were fired. The fireworks shall then be doused with water and allowed to remain for at least 5 additional minutes before being placed in a plastic bucket or fiberboard box. The disposal instructions of the manufacturer as provided by the fireworks supplier shall then be followed in disposing of the fireworks in accordance with Section 31.4.10.
- 31.8.11 Retail display and sale.** Fireworks displayed for retail sale shall not be made readily accessible to the public. A minimum of one pressurized-water portable fire extinguisher complying with Section 7.6 shall be located not more than 4.6 m and not less than 3.1 m from the hazard. “No Smoking” signs complying with Section 5A.10 shall be conspicuously posted in areas where fireworks are stored or displayed for retail sale.

## CHAPTER 32 FLAMMABLE AND COMBUSTIBLE LIQUIDS

### SECTION 32.1 GENERAL

- 32.1.1 Scope and application.** Prevention, control and mitigation of dangerous conditions related to storage, use, dispensing, mixing and handling of flammable and combustible liquids shall be in accordance with Chapter 25 and this chapter.
- 32.1.2 Nonapplicability.** This chapter shall not apply to liquids as otherwise provided in other laws or regulations or chapters of these code requirements, including:
1. Specific provisions for flammable liquids in motor fuel-dispensing facilities, repair garages, airports and marinas in Chapter 20.
  2. Medicines, foodstuffs, cosmetics, and commercial, institutional and industrial products in the same concentration and packaging containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solution not being flammable, in retail or wholesale sales or storage uses when packaged in individual containers not exceeding 5 L.
  3. Storage and use of fuel oil tanks and containers connected to oil-burning equipment. Such storage and use shall be in accordance with Section 5D.3. For abandonment of fuel oil tanks, this chapter applies.
  4. Refrigerant liquids and oils in refrigeration systems (see Section 5D.6).
  5. Storage and display of aerosol products complying with Chapter 26.
  6. Storage and use of liquids that have no fire point when tested in accordance with ASTM D 92.
  7. Liquids with a flash point greater than 35°C in a water-miscible solution or dispersion with a water and inert (noncombustible) solids content of more than 80 percent by weight, which do not sustain combustion.
  8. Liquids without flash points that can be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons.
- 32.1.3 Referenced documents.** The applicable requirements of Chapter 25, other chapters of these code requirements, the SBC 100 and the SBC 501 pertaining to flammable liquids shall apply.
- 32.1.4 Permits.** Permits shall be required as set forth in SBC 100.
- 32.1.5 Material classification.** Flammable and combustible liquids shall be classified in accordance with the definitions in Section 32.2.1.  
When mixed with lower flash-point liquids, Class II or III liquids are capable of assuming the characteristics of the lower flash-point liquids. Under such conditions the appropriate provisions of this chapter for the actual flash point of the mixed liquid shall apply. When heated above their flash points, Class II and III liquids assume the characteristics of Class I liquids. Under such conditions, the appropriate provisions of this chapter for flammable liquids shall apply.

## SECTION 32.2

### DEFINITIONS

**32.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**BULK PLANT OR TERMINAL.** That portion of a property where flammable or combustible liquids are received by tank vessel, pipelines, tank car or tank vehicle and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, portable tank or container.

**BULK TRANSFER.** The loading or unloading of flammable or combustible liquids from or between tank vehicles, tank cars or storage tanks.

**COMBUSTIBLE LIQUID.** A liquid having a closed cup flash point at or above 38°C. Combustible liquids shall be subdivided as follows:

**Class II.** Liquids having a closed cup flash point at or above 38°C and below 60°C.

**Class IIIA.** Liquids having a closed cup flash point at or above 60°C and below 93°C.

**Class IIIB.** Liquids having closed cup flash points at or above 93°C.

The category of combustible liquids does not include compressed gases or cryogenic fluids.

**FIRE POINT.** The lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame in accordance with ASTM D 92.

**FLAMMABLE LIQUID.** A liquid having a closed cup flash point below 38°C. Flammable liquids are further categorized into a group known as Class I liquids. The Class I category is subdivided as follows:

**Class IA.** Liquids having a flash point below 23°C and having a boiling point below 38°C.

**Class IB.** Liquids having a flash point below 23°C and having a boiling point at or above 38°C.

**Class IC.** Liquids having a flash point at or above 23°C and below 38°C.

The category of flammable liquids does not include compressed gases or cryogenic fluids.

**FLASH POINT.** The minimum temperature in degrees Celsius at which a liquid will give off sufficient vapors to form an ignitable mixture with air near the surface or in the container, but will not sustain combustion. The flash point of a liquid shall be determined by appropriate test procedure and apparatus as specified in ASTM D56, ASTM D93 or ASTM D3278.

**FUEL LIMIT SWITCH.** A mechanism, located on a tank vehicle, that limits the quantity of product dispensed at one time.

**LIQUID STORAGE ROOM.** A room classified as a Group H-3 occupancy used for the storage of flammable or combustible liquids in a closed condition.

**MOBILE FUELING.** The operation of dispensing liquid fuels from tank vehicles into the fuel tanks of motor vehicles. Mobile fueling may also be known by the terms

“Mobile Fleet Fueling,” “Wet Fueling” and “Wet Hosing.”

**PROCESS TRANSFER.** The transfer of flammable or combustible liquids between tank vehicles or tank cars and process operations. Process operations may include containers, tanks, piping and equipment.

**REFINERY.** A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline or other hydrocarbon sources.

**REMOTE EMERGENCY SHUTOFF DEVICE.** The combination of an operator-carried signaling device and a mechanism on the tank vehicle. Activation of the remote emergency shutoff device sends a signal to the tanker-mounted mechanism and causes fuel flow to cease.

**REMOTE SOLVENT RESERVOIR.** A liquid solvent container enclosed against evaporative losses to the atmosphere during periods when the container is not being utilized, except for a solvent return opening not larger than 10,322 mm<sup>2</sup>. Such return allows pump-cycled used solvent to drain back into the reservoir from a separate solvent sink or work area.

**SOLVENT DISTILLATION UNIT.** An appliance that receives contaminated flammable or combustible liquids and which distills the contents to remove contaminants and recover the solvents.

**TANK, PRIMARY.** A listed atmospheric tank used to store liquid. See “Primary containment.”

**TANK, PROTECTED ABOVE GROUND.** A tank listed in accordance with UL 2085 consisting of a primary tank provided with protection from physical damage and fire-resistive protection from a high-intensity liquid pool fire exposure. The tank may provide protection elements as a unit or may be an assembly of components, or a combination thereof.

### SECTION 32.3 GENERAL REQUIREMENTS

- 32.3.1 **Electrical.** Electrical wiring and equipment shall be installed and maintained in accordance with the SBC 401.
- 32.3.1.1 **Classified locations for flammable liquids.** Areas where flammable liquids are stored, handled, dispensed or mixed shall be in accordance with Table 32.3.1.1. A classified area shall not extend beyond an unpierced floor, roof or other solid partition. The extent of the classified area is allowed to be reduced, or eliminated, where sufficient technical justification is provided to the building code official that a concentration in the area in excess of 25 percent of the lower flammable limit (LFL) cannot be generated.
- 32.3.1.2 **Classified locations for combustible liquids.** Areas where Class II or III liquids are heated above their flash points shall have electrical installations in accordance with Section 32.3.1.1.  
**Exception:** Solvent distillation units in accordance with Section 32.5.4.
- 32.3.1.3 **Other applications.** The building code official is authorized to determine the extent of the Class I electrical equipment and wiring location when a condition is not specifically covered by these requirements or the SBC 401.

**TABLE 32.3.1.1**  
**CLASS I ELECTRICAL EQUIPMENT LOCATIONS<sup>a</sup>**

LOCATION	GROUP D DIVISION	EXTENT OF CLASSIFIED AREA
<b>Underground tank fill opening</b>	1 2	Pits, boxes or spaces below grade level, any part of which is within the Division 1 or 2 classified area. Up to 457 mm above grade level within a horizontal radius of 3 m from a loose-fill connection and within a horizontal radius of 1.5 m from a tight-fill connection.
<b>Vent—Discharging upward</b>	1 2	Within 900 mm of open end of vent, extending in all directions. Area between 900 mm and 1.5 m of open end of vent, extending in all directions.
<b>Drum and container filling</b> Outdoor or indoor with adequate ventilation	1 2	Within 900 mm of vent and fill opening, extending in all directions. Area between 900 mm and 1.5 m from vent of fill opening, extending in all directions. Also up to 457 mm above floor or grade level within a horizontal radius of 3 m from vent or fill opening.
<b>Pumps, bleeders, withdrawal fittings, meters and similar devices</b> Indoor Outdoor	2 2	Within 1.5 m of any edge of such devices, extending in all directions. Also up to 900 mm above floor or grade level within 7.6 m horizontally from any edge of such devices. Within 900 mm of any edge of such devices, extending in all directions. Also up to 457 mm horizontally from an edge of such devices.
<b>Pits</b> Without mechanical ventilation With mechanical ventilation Containing valves, fittings or piping, and not within a Division 1 or 2 classified area	1 2 2	Entire area within pit if any part is within a Division 1 or 2 classified area. Entire area within pit if any part is within a Division 1 or 2 classified area. Entire pit.
<b>Drainage ditches, separators, impounding basins</b> Indoor Outdoor	1 or 2 2	Same as pits. Area up to 457 mm above ditch, separator or basin. Also up to 457 mm above grade within 4.6 m horizontal from any edge.
<b>Tank vehicle and tank car<sup>b</sup></b> Loading through open dome Loading through bottom connections with atmospheric venting Office and restrooms	1 2 1 2  Ordinary	Within 900 mm of edge of dome, extending in all directions. Area between 900 mm and 4.6 m from edge of dome, extending in all directions. Within 900 mm of point of venting to atmosphere, extending in all directions. Area between 900 mm and 4.6 m from point of venting to atmosphere, extending in all directions. Also up to 457 mm above grade within a horizontal radius of 3 m from point of loading connection. Where there is an opening to these rooms within the extent of an indoor classified location, the room shall be classified the same as if the wall, curb or partition did not exist.

(continued)



**TABLE 32.3.1.1—continued**  
**CLASS I ELECTRICAL EQUIPMENT LOCATIONS<sup>a</sup>**

LOCATION	GROUP D DIVISION	EXTENT OF CLASSIFIED AREA
<b>Tank vehicle and tank car<sup>b</sup>—continued</b> Loading through closed dome with atmospheric venting	1 2	Within 900 mm of open end of vent, extending in all directions. Area between 900 mm and 4.6 m from open end of vent, extending in all directions. Also within 900 mm of edge of dome, extending in all directions.
Loading through closed dome with vapor control	2	Within 900 mm of point of connection of both fill and vapor lines, extending in all directions.
Bottom loading with vapor control or any bottom unloading	2	Within 900 mm of point of connection, extending in all directions. Also up to 457 mm above grade within a horizontal radius of 3 m from point of connection.
<b>Storage and repair garage for tank vehicles</b>	1 2	Pits or spaces below floor level. Area up to 457 mm above floor or grade level for entire storage or repair garage.
<b>Garages for other than tank vehicles</b>	Ordinary	Where there is an opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
<b>Outdoor drum storage</b>	Ordinary	
<b>Indoor warehousing where there is no flammable liquid transfer</b>	Ordinary	Where there is an opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb or partition did not exist.
<b>Indoor equipment where flammable vapor/air mixtures could exist under normal operations</b>	1 2	Area within 1.5 m of any edge of such equipment, extending in all directions. Area between 1.5 m and 2.4 m of any edge of such equipment, extending in all directions. Also, area up to 900 mm above floor or grade level within 1.5 m to 7.6 m horizontally from any edge of such equipment. <sup>c</sup>
<b>Outdoor equipment where flammable vapor/air mixtures could exist under normal operations</b>	1 2	Area within 900 mm of any edge of such equipment, extending in all directions. Area between 900 mm and 2.4 m of any edge of such equipment extending in all directions. Also, area up to 900 mm above floor or grade level within 900 mm to 3 m horizontally from any edge of such equipment.
<b>Tank — Above ground</b> Shell, ends or roof and dike area	1	Area inside dike where dike height is greater than the distance from the tank to the dike for more than 50 percent of the tank circumference.
Vent	2 1 2	Area within 3 m from shell ends or roof of tank. Area inside dikes to level of top of dike. Area within 1.5 m of open end of vent, extending in all directions.
Floating roof	2 1	Area between 1.5 m and 3 m from open end of vent, extending in all directions. Area above the roof and within the shell.

a. Locations as classified in the SBC 401.

b. When classifying extent of area, consideration shall be given to the fact that tank cars or tank vehicles can be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.

c. The release of Class I liquids can generate vapors to the extent that the entire building, and possibly a zone surrounding it, are considered a Class I, Division 2 location.

- 32.3.2 Fire protection.** Fire protection for the storage, use, dispensing, mixing, handling and on-site transportation of flammable and combustible liquids shall be in accordance with this chapter and applicable sections of Chapter 7.
- 32.3.2.1 Portable fire extinguishers and hose lines.** Portable fire extinguishers shall be provided in accordance with Section 7.6. Hose lines shall be provided in accordance with Section 7.5.
- 32.3.3 Site assessment.** In the event of a spill, leak or discharge from a tank system, a site assessment shall be completed by the owner or operator of such tank system if the building code official determines that a potential fire or explosion hazard exists. Such site assessments shall be conducted to ascertain potential fire hazards and shall be completed and submitted to the Civil Defence within a time period established by the building code official, not to exceed 60 days.
- 32.3.4 Spill control and secondary containment.** Where the maximum allowable quantity per control area is exceeded, and when required by Section 25.4.2, rooms, buildings or areas used for storage, dispensing, use, mixing or handling of Class I, II and III-A liquids shall be provided with spill control and secondary containment in accordance with Section 25.4.2.
- 32.3.5 Labeling and signage.** The building code official is authorized to require warning signs for the purpose of identifying the hazards of storing or using flammable liquids. Signage for identification and warning such as for the inherent hazard of flammable liquids or smoking shall be provided in accordance with this chapter and Sections 25.3.5 and 25.3.6.
- 32.3.5.1 Style.** Warning signs shall be of a durable material. Signs warning of the hazard of flammable liquids shall have white lettering on a red background and shall read: **DANGER – FLAMMABLE LIQUIDS**. Letters shall not be less than 76 mm in height and 12.7 mm in stroke.
- 32.3.5.2 Location.** Signs shall be posted in locations as required by the building code official. Piping containing flammable liquids shall be identified in accordance with ANSI A13.1.
- 32.3.5.3 Warning labels.** Individual containers, packages and cartons shall be identified, marked, labeled and placarded in accordance with SBC 100 and SASO standards.
- 32.3.5.4 Identification.** Color coding or other approved identification means shall be provided on each loading and unloading riser for flammable or combustible liquids to identify the contents of the tank served by the riser.
- 32.3.6 Piping systems.** Piping systems, and their component parts, for flammable and combustible liquids shall be in accordance with this section.
- 32.3.6.1 Nonapplicability.** The provisions of Section 32.3.6 shall not apply to gas or oil well installations; piping that is integral to stationary or portable engines, including aircraft, watercraft and motor vehicles; and piping in connection with boilers and pressure vessels regulated by the SBC 501.
- 32.3.6.2 Design and fabrication of system components.** Piping system components shall be designed and fabricated in accordance with NFPA 30, Chapter 5, except as modified by this section.
- 32.3.6.2.1 Special materials.** Low-melting-point materials (such as aluminum, copper or brass), materials that soften on fire exposure (such as nonmetallic materials) and nonductile material (such as cast iron) shall be acceptable for use underground in accordance with ANSI B31.9. When such materials are used outdoors in above-ground piping systems or within buildings, they shall be in accordance with ANSI B31.9 and one of the following:

1. Suitably protected against fire exposure.
2. Located where leakage from failure would not unduly expose people or structures.
3. Located where leakage can be readily controlled by operation of accessible remotely located valves. In all cases, nonmetallic piping shall be used in accordance with Section 5A.3.6 of NFPA 30.

- 32.3.6.3 Testing.** Unless tested in accordance with the applicable section of ANSI B31.9, piping, before being covered, enclosed or placed in use, shall be hydrostatically tested to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system, but not less than 34.5 kPa at the highest point of the system. This test shall be maintained for a sufficient time period to complete visual inspection of joints and connections. For a minimum of 10 minutes, there shall be no leakage or permanent distortion. Care shall be exercised to ensure that these pressures are not applied to vented storage tanks. Such storage tanks shall be tested independently from the piping.
- 32.3.6.3.1 Existing piping.** Existing piping shall be tested in accordance with this section when the building code official has reasonable cause to believe that a leak exists. Piping that could contain flammable or combustible liquids shall not be tested pneumatically. Such tests shall be at the expense of the owner or operator.
- Exception:** Vapor-recovery piping is allowed to be tested using an inert gas.
- 32.3.6.4 Protection from vehicles.** Guard posts or other approved means shall be provided to protect piping, valves or fittings subject to vehicular damage in accordance with Section 5A.12.
- 32.3.6.5 Protection from corrosion and galvanic action.** Where subject to external corrosion, piping, related fluid-handling components and supports for both underground and above-ground applications shall be fabricated from noncorrosive materials, and coated or provided with corrosion protection. Dissimilar metallic parts that promote galvanic action shall not be joined.
- 32.3.6.6 Valves.** Piping systems shall contain a sufficient number of manual control valves and check valves to operate the system properly and to protect the plant under both normal and emergency conditions. Piping systems in connection with pumps shall contain a sufficient number of such valves to control properly the flow of liquids in normal operation and in the event of physical damage or fire exposure.
- 32.3.6.6.1 Backflow protections.** Connections to pipelines or piping by which equipment (such as tank cars, tank vehicles or marine vessels) discharges liquids into storage tanks shall be provided with check valves or block valves for automatic protection against backflow where the piping arrangement is such that backflow from the system is possible. Where loading and unloading is done through a common pipe system, a check valve is not required. However, a block valve shall be provided which is located so as to be readily accessible or remotely operable.
- 32.3.6.6.2 Manual drainage.** Manual drainage-control valves shall be located at approved locations remote from the tanks, diked area, drainage system and impounding basin to ensure their operation in a fire condition.
- 32.3.6.7 Connections.** Above-ground tanks with connections located below normal liquid level shall be provided with internal or external isolation valves located as close as practical to the shell of the tank. Except for liquids whose chemical characteristics are incompatible with steel, such valves, when external, and their connections to the tank shall be of steel.
- 32.3.6.8 Piping supports.** Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibration, expansion, contraction or exposure to fire. The supports shall be protected against exposure to fire by one of the following:

1. Draining liquid away from the piping system at a minimum slope of not less than 1 percent.
2. Providing protection with a fire-resistance rating of not less than 2 hours.
3. Other approved methods.

**32.3.6.9 Flexible joints.** Flexible joints shall be listed and approved and shall be installed on underground liquid, vapor and vent piping at all of the following locations:

1. Where piping connects to underground tanks.
2. Where piping ends at pump islands and vent risers.
3. At points where differential movement in the piping can occur.

**32.3.6.9.1 Fiberglass-reinforced plastic piping.** Fiberglass-reinforced plastic (FRP) piping is not required to be provided with flexible joints in locations where both of the following conditions are present:

1. Piping does not exceed 100 mm in diameter.
2. Piping has a straight run of not less than 1.2 m on one side of the connection when such connections result in a change of direction.

In lieu of the minimum 1.2 m straight run length, approved and listed flexible joints are allowed to be used under dispensers and suction pumps, at submerged pumps and tanks, and where vents extend above-ground.

**32.3.6.10 Pipe joints.** Joints shall be liquid tight and shall be welded, flanged or threaded except that listed flexible connectors are allowed in accordance with Section 32.3.6.9. Threaded or flanged joints shall fit tightly by using approved methods and materials for the type of joint. Joints in piping systems used for Class I liquids shall be welded when located in concealed spaces within buildings. Nonmetallic joints shall be approved and shall be installed in accordance with the manufacturer's instructions. Pipe joints that are dependent on the friction characteristics or resiliency of combustible materials for liquid tightness of piping shall not be used in buildings. Piping shall be secured to prevent disengagement at the fitting.

**32.3.6.11 Bends.** Pipe and tubing shall be bent in accordance with ANSI B31.9.

## SECTION 32.4 STORAGE

**32.4.1 General.** The storage of flammable and combustible liquids in containers and tanks shall be in accordance with this section and the applicable sections of Chapter 25.

**32.4.2 Tank storage.** The provisions of this section shall apply to:

1. The storage of flammable and combustible liquids in fixed above-ground and underground tanks.
2. The storage of flammable and combustible liquids in fixed above-ground tanks inside of buildings.
3. The storage of flammable and combustible liquids in portable tanks whose capacity exceeds 2498 L.
4. The installation of such tanks and portable tanks.

**32.4.2.1 Change of tank contents.** Tanks subject to change in contents shall be in accordance with Section 32.4.2.7. Prior to a change in contents, the building code official is authorized to require testing of a tank.

Tanks that have previously contained Class I liquids shall not be loaded with Class II or Class III liquids until such tanks and all piping, pumps, hoses and meters connected thereto have been completely drained and flushed.

**32.4.2.2 Use of tank vehicles and tank cars as storage tanks.** Tank cars and tank vehicles shall not be used as storage tanks.

- 32.4.2.3 Labeling and signs.** Labeling and signs for storage tanks and storage tank areas shall comply with Sections 32.4.2.3.1 and 32.4.2.3.2.
- 32.4.2.3.1 Smoking and open flame.** Signs shall be posted in storage areas prohibiting open flames and smoking. Signs shall comply with Section 32.3.5.
- 32.4.2.3.2 Label or placard.** Tanks more than 379 L in capacity, which are permanently installed or mounted and used for the storage of Class I, II or IIIA liquids, shall bear a label and placard identifying the material therein. Placards shall be in accordance with NFPA 704.
- Exceptions:**
1. Tanks of 1,136 L capacity or less located on private property and used for heating and cooking fuels in single-family dwellings.
  2. Tanks located underground.
- 32.4.2.4 Sources of ignition.** Smoking and open flames are prohibited in storage areas in accordance with Section 25.3.7.
- Exception:** Areas designated as smoking and hot work areas and areas where hot work permits have been issued in accordance with these code requirements.
- 32.4.2.5 Explosion control.** Explosion control shall be provided in accordance with Section 7.11.
- 32.4.2.6 Separation from incompatible materials.** Storage of flammable and combustible liquids shall be separated from incompatible materials in accordance with Section 25.3.9.8.
- Grass, weeds, combustible materials and waste Class I, II or IIIA liquids shall not be accumulated in an unsafe manner at a storage site.
- 32.4.2.7 Design, construction and general installation requirements for tanks.** The design, fabrication and construction of tanks shall comply with NFPA 30. Each tank shall bear a permanent nameplate or marking indicating the standard used as the basis of design.
- 32.4.2.7.1 Materials used in tank construction.** The materials used in tank construction shall be in accordance with NFPA 30.
- 32.4.2.7.2 Pressure limitations for tanks.** Tanks shall be designed for the pressures to which they will be subjected in accordance with NFPA 30.
- 32.4.2.7.3 Tank vents for normal venting.** Tank vents for normal venting shall be installed and maintained in accordance with Sections 32.4.2.7.3.1 through 32.4.2.7.3.6.
- 32.4.2.7.3.1 Vent lines.** Vent lines from tanks shall not be used for purposes other than venting unless approved.
- 32.4.2.7.3.2 Vent-line flame arresters and venting devices.** Vent-line flame arresters and venting devices shall be installed in accordance with their listings. Use of flame arresters in piping systems shall be in accordance with API 2028.
- 32.4.2.7.3.3 Vent pipe outlets.** Vent pipe outlets for tanks storing Class I, II or IIIA liquids shall be located such that the vapors are released at a safe point outside of buildings and not less than 3.7 m above the adjacent ground level. Vapors shall be discharged upward or horizontally away from adjacent walls to assist in vapor dispersion. Vent outlets shall be located such that flammable vapors will not be trapped by eaves or other obstructions and shall be at least 1.5 m from building openings or lot lines of properties that can be built upon. Vent outlets on atmospheric tanks storing Class IIIB liquids are allowed to discharge inside a building if the vent is a normally closed vent.
- 32.4.2.7.3.4 Installation of vent piping.** Vent piping shall be designed, sized, constructed and installed in accordance with Section 32.3.6. Vent pipes shall be installed such that they will drain toward the tank without sags or traps in which liquid can collect. Vent pipes shall be installed in such a manner so as not to be subject to physical damage or vibration.
- 32.4.2.7.3.5 Manifolding.** Tank vent piping shall not be manifolded unless required for special purposes such as vapor recovery, vapor conservation or air pollution control.

- 32.4.2.7.3.5.1 Above-ground tanks.** For above-ground tanks, manifolded vent pipes shall be adequately sized to prevent system pressure limits from being exceeded when manifolded tanks are subject to the same fire exposure.
- 32.4.2.7.3.5.2 Underground tanks.** For underground tanks, manifolded vent pipes shall be sized to prevent system pressure limits from being exceeded when manifolded tanks are filled simultaneously.
- 32.4.2.7.3.5.3 Tanks storing Class I liquids.** Vent piping for tanks storing Class I liquids shall not be manifolded with vent piping for tanks storing Class II and III liquids unless positive means are provided to prevent the vapors from Class I liquids from entering tanks storing Class II and III liquids, to prevent contamination and possible change in classification of less volatile liquid.
- 32.4.2.7.3.6 Tank venting for tanks and pressure vessels storing Class IB and IC liquids.** Tanks and pressure vessels storing Class IB or IC liquids shall be equipped with venting devices which shall be normally closed except when venting under pressure or vacuum conditions, or with listed flame arresters. The vents shall be installed and maintained in accordance with Section 2.2.5.1 of NFPA 30 or API 2000.
- 32.4.2.7.4 Emergency venting.** Stationary, above-ground tanks shall be equipped with additional venting that will relieve excessive internal pressure caused by exposure to fires. Emergency vents for Class I, II and IIIA liquids shall not discharge inside buildings. The venting shall be installed and maintained in accordance with Section 2.2.5.2 of NFPA 30.
- Exception:** Tanks larger than 45,420 L in capacity storing Class IIIB liquids which are not within the diked area or the drainage path of Class I or II liquids do not require emergency relief venting.
- 32.4.2.7.5 Tank openings other than vents.** Tank openings for other than vents shall comply with Sections 32.4.2.7.5.1 through 32.4.2.7.5.8.
- 32.4.2.7.5.1 Connections below liquid level.** Connections for tank openings below the liquid level shall be liquid tight.
- 32.4.2.7.5.2 Filling, emptying and vapor recovery connections.** Filling, emptying and vapor recovery connections to tanks containing Class I, II or IIIA liquids shall be located outside of buildings at a location free from sources of ignition and not less than 1.5 m away from building openings or lot lines of property that can be built on. Such openings shall be provided with a liquid-tight cap which shall be closed when not in use and properly identified.
- 32.4.2.7.5.3 Piping, connections and fittings.** Piping, connections, fittings and other appurtenances shall be installed in accordance with Section 32.3.6.
- 32.4.2.7.5.4 Manual gauging.** Openings for manual gauging, if independent of the fill pipe, shall be provided with a liquid-tight cap or cover. Covers shall be kept closed when not gauging. If inside a building, such openings shall be protected against liquid overflow and possible vapor release by means of a spring-loaded check valve or other approved device.
- 32.4.2.7.5.5 Fill pipes and discharge lines.** For top-loaded tanks, a metallic fill pipe shall be designed and installed to minimize the generation of static electricity by terminating the pipe within 150 mm of the bottom of the tank, and it shall be installed in a manner which avoids excessive vibration.
- 32.4.2.7.5.5.1 Class I liquids.** For Class I liquids other than crude oil, gasoline and asphalt, the fill pipe shall be designed and installed in a manner which will minimize the possibility of generating static electricity by terminating within 150 mm of the bottom of the tank.
- 32.4.2.7.5.5.2 Underground tanks.** For underground tanks, fill pipe and discharge lines shall enter only through the top. Fill lines shall be sloped toward the tank. Underground tanks for

Class I liquids having a capacity greater than 3,785 L shall be equipped with a tight fill device for connecting the fill hose to the tank.

- 32.4.2.7.5.6 Location of connections that are made or broken.** Filling, withdrawal and vapor-recovery connections for Class I, II and IIIA liquids which are made and broken shall be located outside of buildings at a location away from sources of ignition and not less than 1.5 m away from building openings. Such connections shall be closed and liquid tight when not in use and shall be properly identified.
- 32.4.2.7.5.7 Protection against vapor release.** Tank openings provided for purposes of vapor recovery shall be protected against possible vapor release by means of a spring-loaded check valve or dry-break connections, or other approved device, unless the opening is a pipe connected to a vapor processing system. Openings designed for combined fill and vapor recovery shall also be protected against vapor release unless connection of the liquid delivery line to the fill pipe simultaneously connects the vapor recovery line. Connections shall be vapor tight.
- 32.4.2.7.5.8 Overfill prevention.** An approved means or method in accordance with Section 32.4.2.9.6.6 shall be provided to prevent the overfill of all Class I, II and IIIA liquid storage tanks.
- 32.4.2.7.6 Repair, alteration or reconstruction of tanks and piping.** The repair, alteration or reconstruction, including welding, cutting and hot tapping of storage tanks and piping that have been placed in service, shall be in accordance with NFPA 30.
- 32.4.2.7.7 Design of supports.** The design of the supporting structure for tanks shall be in accordance with the SBC 100 and NFPA 30.
- 32.4.2.7.8 Locations subject to flooding.** Where a tank is located in an area where it is subject to buoyancy because of a rise in the water table, flooding or accumulation of water from fire suppression operations, uplift protection shall be provided in accordance with Sections 2.3.2.6 and 2.3.3.5 of NFPA 30.
- 32.4.2.7.9 Corrosion protection.** Where subject to external corrosion, tanks shall be fabricated from corrosion-resistant materials, coated or provided with corrosion protection in accordance with Section 2.2.6.1 of NFPA 30.
- 32.4.2.7.10 Leak reporting.** A consistent or accidental loss of liquid, or other indication of a leak from a tank system, shall be reported immediately to the Civil Defence and the building code official.
- 32.4.2.7.10.1 Leaking tank disposition.** Leaking tanks shall be promptly emptied, repaired and returned to service, abandoned or removed in accordance with Section 32.4.2.13 or 32.4.2.14.
- 32.4.2.7.11 Tank lining.** Steel tanks are allowed to be lined only for the purpose of protecting the interior from corrosion or providing compatibility with a material to be stored. Only those liquids tested for compatibility with the lining material are allowed to be stored in lined tanks.
- 32.4.2.8 Vaults.** Vaults shall be allowed to be either above or below grade and shall comply with Sections 32.4.2.8.1 through 32.4.2.8.1.
- 32.4.2.8.1 Listing required.** Vaults shall be listed in accordance with UL 2245.  
**Exception:** Where approved by the building code official, below-grade vaults are allowed to be constructed on site, provided that the design is in accordance with the SBC and that special inspections are conducted to verify structural strength and compliance of the installation with the approved design in accordance with the SBC, Section 15.7. Installation plans for below-grade vaults that are constructed on site shall be prepared by a professional engineer. Consideration shall be given to soil and hydrostatic loading on the floors, walls and lid; anticipated seismic forces; uplifting by ground water or flooding; and to loads imposed from above such as traffic and equipment loading on the vault lid.

- 32.4.2.8.2 Design and construction.** The vault shall completely enclose each tank. There shall be no openings in the vault enclosure except those necessary for access to, inspection of, and filling, emptying and venting of the tank. The walls and floor of the vault shall be constructed of reinforced concrete at least 150 mm thick. The top of an above-grade vault shall be constructed of noncombustible material and shall be designed to be weaker than the walls of the vault, to ensure that the thrust of an explosion occurring inside the vault is directed upward before significantly high pressure can develop within the vault. The top of an at-grade or below-grade vault shall be designed to relieve safely or contain the force of an explosion occurring inside the vault. The top and floor of the vault and the tank foundation shall be designed to withstand the anticipated loading, including loading from vehicular traffic, where applicable. The walls and floor of a vault installed below grade shall be designed to withstand anticipated soil and hydrostatic loading. Vaults shall be designed to be wind and earthquake resistant, in accordance with the SBC.
- 32.4.2.8.3 Secondary containment.** Vaults shall be substantially liquid tight and there shall be no backfill around the tank or within the vault. The vault floor shall drain to a sump. For premanufactured vaults, liquid tightness shall be certified as part of the listing provided by a nationally recognized testing laboratory. For field-erected vaults, liquid tightness shall be certified in an approved manner.
- 32.4.2.8.4 Internal clearance.** There shall be sufficient clearance between the tank and the vault to allow for visual inspection and maintenance of the tank and its appurtenances. Dispensing devices are allowed to be installed on tops of vaults.
- 32.4.2.8.5 Anchoring.** Vaults and their tanks shall be suitably anchored to withstand uplifting by ground water or flooding, including when the tank is empty.
- 32.4.2.8.6 Vehicle impact protection.** Vaults shall be resistant to damage from the impact of a motor vehicle, or vehicle impact protection shall be provided in accordance with Section 5A.12.
- 32.4.2.8.7 Arrangement.** Tanks shall be listed for above-ground use, and each tank shall be in its own vault. Compartmentalized tanks shall be allowed and shall be considered as a single tank. Adjacent vaults shall be allowed to share a common wall. The common wall shall be liquid and vapor tight and shall be designed to withstand the load imposed when the vault on either side of the wall is filled with water.
- 32.4.2.8.8 Connections.** Connections shall be provided to permit venting of each vault to dilute, disperse and remove vapors prior to personnel entering the vault.
- 32.4.2.8.9 Ventilation.** Vaults that contain tanks of Class I liquids shall be provided with an exhaust ventilation system installed in accordance with Section 25.4.3. The ventilation system shall operate continuously or be designed to operate upon activation of the vapor or liquid detection system. The system shall provide ventilation at a rate of not less than  $0.0051 \text{ m}^3/(\text{s} \cdot \text{m}^2)$ , but not less than  $0.762 \text{ m}^3/(\text{s} \cdot \text{m}^2)$ . The exhaust system shall be designed to provide air movement across all parts of the vault floor. Supply and exhaust ducts shall extend to within 76 mm), but not more than 300 mm of the floor. The exhaust system shall be installed in accordance with the SBC 501.
- 32.4.2.8.10 Liquid detection.** Vaults shall be equipped with a detection system capable of detecting liquids, including water, and activating an alarm.
- 32.4.2.8.11 Monitoring and detection.** Vaults shall be provided with approved vapor and liquid detection systems and equipped with on-site audible and visual warning devices with battery backup. Vapor detection systems shall sound an alarm when the system detects vapors that reach or exceed 25 percent of the lower explosive limit (LEL) of the liquid stored. Vapor detectors shall be located no higher than 300 mm above the lowest point in the vault. Liquid detection systems shall sound an alarm upon detection of any liquid, including water. Liquid detectors shall be located in accordance with the manufacturer's



instructions. Activation of either vapor or liquid detection systems shall cause a signal to be sounded at an approved, constantly attended location within the facility serving the tanks or at an approved location. Activation of vapor detection systems shall also shutoff dispenser pumps.

- 32.4.2.8.12 Liquid removal.** Means shall be provided to recover liquid from the vault. Where a pump is used to meet this requirement, the pump shall not be permanently installed in the vault. Electric-powered portable pumps shall be suitable for use in Class I, Division 1 locations, as defined in the SBC 401.
- 32.4.2.8.13 Normal vents.** Vent pipes that are provided for normal tank venting shall terminate at least 3.7 m above ground level.
- 32.4.2.8.14 Emergency vents.** Emergency vents shall be vapor tight and shall be allowed to discharge inside the vault. Long-bolt manhole covers shall not be permitted for this purpose.
- 32.4.2.8.15 Accessway.** Vaults shall be provided with an approved personnel accessway with a minimum dimension of 760 mm and with a permanently affixed, nonferrous ladder. Accessways shall be designed to be nonsparking. Travel distance from any point inside a vault to an accessway shall not exceed 6.1 m. At each entry point, a warning sign indicating the need for procedures for safe entry into confined spaces shall be posted. Entry points shall be secured against unauthorized entry and vandalism.
- 32.4.2.8.16 Fire protection.** Vaults shall be provided with a suitable means to admit a fire suppression agent.
- 32.4.2.8.17 Classified area.** The interior of a vault containing a tank that stores a Class I liquid shall be designated a Class I, Division 1 location, as defined in the SBC 401.
- 32.4.2.8.18 Overfill protection.** Overfill protection shall be provided in accordance with Section 32.4.2.9.6.6. The use of a float vent valve shall be prohibited.
- 32.4.2.9 Above-ground tanks.** Above-ground storage of flammable and combustible liquids in tanks shall comply with Section 32.4.2 and Sections 32.4.2.9.1 through 32.4.2.9.6.10.
- 32.4.2.9.1 Fire protection.** Fire protection for above-ground tanks shall comply with Sections 32.4.2.9.1.1 through 32.4.2.9.1.4.
- 32.4.2.9.1.1 Required foam fire protection systems.** When required by the building code official, foam fire protection shall be provided for above-ground tanks, other than pressure tanks operating at or above 6.89 kPa when such tank, or group of tanks spaced less than 15.2 m apart measured shell to shell, has a liquid surface area in excess of 139 m<sup>2</sup>, and is in accordance with one of the following:
  - 1. Used for the storage of Class I or II liquids.
  - 2. Used for the storage of crude oil.
  - 3. Used for in-process products and is located within 30.5 m of a fired still, heater, related fractioning or processing apparatus or similar device at a processing plant or petroleum refinery as herein defined.
  - 4. Considered by the building code official as posing an unusual exposure hazard because of topographical conditions; nature of occupancy, proximity on the same or adjoining property, and height and character of liquids to be stored; degree of private fire protection to be provided; and facilities of the Civil Defence to cope with flammable liquid fires.
- 32.4.2.9.1.2 Foam fire protection system installation.** Where foam fire protection is required, it shall be installed in accordance with NFPA 11 and NFPA 11A.
- 32.4.2.9.1.2.1 Foam storage.** Where foam fire protection is required, foam-producing materials shall be stored on the premises.
 

**Exception:** Storage of foam-producing materials off the premises is allowed as follows:

  - 1. Such materials stored off the premises shall be of the proper type suitable for use with the equipment at the installation where required.

2. Such materials shall be readily available at the storage location at all times.
3. Adequate loading and transportation facilities shall be provided.
4. The time required to deliver such materials to the required location in the event of fire shall be consistent with the hazards and fire scenarios for which the foam supply is intended.
5. At the time of a fire, these off-premises supplies shall be accumulated in sufficient quantities before placing the equipment in operation to ensure foam production at an adequate rate without interruption until extinguishment is accomplished.

**32.4.2.9.1.3 Fire protection of supports.** Supports or pilings for above-ground tanks storing Class I, II or IIIA liquids elevated more than 305 mm above grade shall have a fire-resistance rating of not less than 2 hours in accordance with the fire exposure criteria specified in ASTM E 1529.

**Exceptions:**

1. Structural supports tested as part of a protected above-ground tank in accordance with UL 2085.
2. Stationary tanks located outside of buildings when protected by an approved water-spray system designed in accordance with Chapter 7 and NFPA 15.
3. Stationary tanks located inside of buildings equipped throughout with an approved automatic sprinkler system designed in accordance with Section 7.3.3.1.1.

**32.4.2.9.1.4 Inerting of tanks with boil over liquids.** Liquids with boil over characteristics shall not be stored in fixed roof tanks larger than 45.7 m in diameter unless an approved gas enrichment or inerting system is provided on the tank.

**Exception:** Crude oil storage tanks in production fields with no other exposures adjacent to the storage tank.

**32.4.2.9.2 Supports, foundations and anchorage.** Supports, foundations and anchorages for above-ground tanks shall be designed and constructed in accordance with NFPA 30 and the SBC 301.

**32.4.2.9.3 Stairs, platforms and walkways.** Stairs, platforms and walkways shall be of noncombustible construction and shall be designed and constructed in accordance with NFPA 30 and the SBC.

**32.4.2.9.4 Above-ground tanks inside of buildings.** Tanks storing Class I, II and IIIA liquids inside buildings shall be equipped with a device or other means to prevent overflow into the building including, but not limited to: a float valve; a preset meter on the fill line; a valve actuated by the weight of the tanks contents; a low head pump which is incapable of producing overflow; or a liquid-tight overflow pipe at least one pipe size larger than the fill pipe and discharging by gravity back to the outside source of liquid or to an approved location.

**32.4.2.9.5 Above-ground tanks outside of buildings.** Above-ground tanks outside of buildings shall comply with Sections 32.4.2.9.5.1 through 32.4.2.9.5.3.

**32.4.2.9.5.1 Locations where above-ground tanks are prohibited.** Storage of Class I and II liquids in above-ground tanks outside of buildings is prohibited.

**32.4.2.9.5.1.1 Location of tanks with pressures 17.2 kPa or less.** Above-ground tanks operating at pressures not exceeding 17.2 kPa for storage of Class I, II or IIIA liquids, which are designed with a floating roof, a weak roof-to-shell seam or equipped with emergency venting devices limiting pressure to 17.2 kPa, shall be located in accordance with Table 2.3.2.1.1(a) of NFPA 30.

**Exceptions:**

1. Vertical tanks having a weak roof-to-shell seam and storing Class IIIA liquids are allowed to be located at one-half the distances specified in Table 2.3.2.1.1(a) of NFPA 30, provided the tanks are not within a diked area or drainage path for a tank storing Class I or II liquids.

2. Liquids with boil over characteristics and unstable liquids in accordance with Sections 32.4.2.9.5.1.4 and 32.4.2.9.5.1.5.
3. For protected above-ground tanks in accordance with Section 32.4.2.9.6 and tanks in at-grade or above-grade vaults in accordance with Section 32.4.2.8, the distances in Table 2.3.2.1.1(b) of NFPA 30 shall apply and shall be reduced by one-half, but not to less than 1.5 m.

**32.4.2.9.5.1.2 Location of tanks with pressures exceeding 17.2 kPa.** Above-ground tanks for the storage of Class I, II or IIIA liquids operating at pressures exceeding 17.2 kPa or equipped with emergency venting allowing pressures to exceed 17.2 kPa shall be located in accordance with Table 2.3.2.1.2 of NFPA 30.

**Exception:** Liquids with boil over characteristics and unstable liquids in accordance with Sections 32.4.2.9.5.1.4 and 32.4.2.9.5.1.5.

**32.4.2.9.5.1.3 Location of tanks for boil over liquids.** Above-ground tanks for storage of liquids with boil over characteristics shall be located in accordance with Table 2.3.2.1.3 of NFPA 30.

**32.4.2.9.5.1.4 Location of tanks for unstable liquids.** Above-ground tanks for the storage of unstable liquids shall be located in accordance with Table 2.3.2.1.4 of NFPA 30.

**32.4.2.9.5.1.5 Location of tanks for Class IIIB liquids.** Above-ground tanks for the storage of Class IIIB liquids, excluding unstable liquids, shall be located in accordance with Table 2.3.2.1.5 of NFPA 30, except when located within a diked area or drainage path for a tank or tanks storing Class I or II liquids. Where a Class IIIB liquid storage tank is within the diked area or drainage path for a Class I or II liquid, distances required by Section 32.4.2.9.5.1.2 shall apply.

**32.4.2.9.5.1.6 Reduction of separation distances to adjacent property.** Where two tank properties of diverse ownership have a common boundary, the code fire official is authorized to, with the written consent of the owners of the two properties, apply the distances in Sections 32.4.2.9.5.1.2 through 32.4.2.9.5.1.6 assuming a single property.

**32.4.2.9.5.2 Separation between adjacent stable or unstable liquid tanks.** The separation between tanks containing stable liquids shall be in accordance with Table 2.3.2.2.1 of NFPA 30. Where tanks are in a diked area containing Class I or II liquids, or in the drainage path of Class I or II liquids, and are compacted in three or more rows or in an irregular pattern, the building code official is authorized to require greater separation than specified in Table 2.3.2.2.1 of NFPA 30 or other means to make tanks in the interior of the pattern accessible for fire-fighting purposes.

**Exception:** Tanks used for storing Class IIIB liquids are allowed to be spaced 900 mm apart unless within a diked area or drainage path for a tank storing Class I or II liquids.

The separation between tanks containing unstable liquids shall not be less than one-half the sum of their diameters.

**32.4.2.9.5.3 Separation between adjacent tanks containing flammable or combustible liquids and LP-gas.** The minimum horizontal separation between an LP-gas container and a Class I, II or IIIA liquid storage tank shall be 6.1 m except in the case of Class I, II or IIIA liquid tanks operating at pressures exceeding 17.2 kPa or equipped with emergency venting allowing pressures to exceed 17.2 kPa, in which case the provisions of Section 32.4.2.9.5.2 shall apply.

An approved means shall be provided to prevent the accumulation of Class I, II or IIIA liquids under adjacent LP-gas containers such as by dikes, diversion curbs or grading. When flammable or combustible liquid storage tanks are within a diked area, the LP-gas containers shall be outside the diked area and at least 3 m away from the centerline of the wall of the diked area.

**Exceptions:**

1. Liquefied petroleum gas containers of 473 L or less in capacity installed adjacent to fuel-oil supply tanks of 2,498 L or less in capacity.

2. Horizontal separation is not required between above-ground LP-gas containers and underground flammable and combustible liquid tanks.

**32.4.2.9.6 Additional requirements for protected above-ground tanks.** In addition to the requirements of this chapter for above-ground tanks, the installation of protected above-ground tanks shall be in accordance with Sections 32.4.2.9.6.1 through 32.4.2.9.6.10.

**32.4.2.9.6.1 Tank construction.** The construction of a protected above-ground tank and its primary tank shall be in accordance with Section 32.4.2.7.

**32.4.2.9.6.2 Normal and emergency venting.** Normal and emergency venting for protected above-ground tanks shall be provided in accordance with Sections 32.4.2.7.3 and 32.4.2.7.4. The vent capacity reduction factor shall not be allowed.

**32.4.2.9.6.3 Flame arresters.** Approved flame arresters or pressure vacuum breather valves shall be installed in normal vents.

**32.4.2.9.6.4 Secondary containment.** Protected above-ground tanks shall be provided with secondary containment, drainage control or diking in accordance with Section 25.4.2. A means shall be provided to establish the integrity of the secondary containment in accordance with NFPA 30.

**32.4.2.9.6.5 Vehicle impact protection.** Where protected above-ground tanks, piping, electrical conduit or dispensers are subject to vehicular impact, they shall be protected therefrom, either by having the impact protection incorporated into the system design in compliance with the impact test protocol of UL 2085, or by meeting the provisions of Section 5A.12, or where necessary, a combination of both. Where guard posts or other approved barriers are provided, they shall be independent of each above-ground tank.

**32.4.2.9.6.6 Overfill prevention.** Protected above-ground tanks shall not be filled in excess of 95 percent of their capacity. An overfill prevention system shall be provided for each tank. During tank-filling operations, the system shall:

1. Provide an independent means of notifying the person filling the tank that the fluid level has reached 90 percent of tank capacity by providing an audible or visual alarm signal, providing a tank level gauge marked at 90 percent of tank capacity, or other approved means.
2. Automatically shutoff the flow of fuel to the tank when the quantity of liquid in the tank reaches 95 percent of tank capacity. For rigid hose fuel-delivery systems, an approved means shall be provided to empty the fill hose into the tank after the automatic shutoff device is activated.
3. Reduce the flow rate to not more than 0.95 L/sec so that at the reduced flow rate, the tank will not overfill for 30 minutes, and automatically shutoff flow into the tank so that none of the fittings on the top of the tank are exposed to product because of overfilling.

A permanent sign shall be provided at the fill point for the tank, documenting the filling procedure and the tank calibration chart.

**Exception:** Where climatic conditions are such that the sign may be obscured by ice or snow, or weathered beyond readability or otherwise impaired, said procedures and chart shall be located in the office window, lock box or other area accessible to the person filling the tank.

The filling procedure shall require the person filling the tank to determine the literage required to fill it to 90 percent of capacity before commencing the fill operation.

**32.4.2.9.6.7 Fill pipe connections.** The fill pipe shall be provided with a means for making a direct connection to the tank vehicle's fuel delivery hose so that the delivery of fuel is not exposed to the open air during the filling operation. Where any portion of the fill pipe exterior to the tank extends below the level of the top of the tank, a check valve shall be installed in the fill pipe not more than 305 mm from the fill hose connection.

**32.4.2.9.6.8 Spill containers.** A spill container having a capacity of not less than 19 L shall be provided for each fill connection. For tanks with a top fill connection, spill containers shall be noncombustible and shall be fixed to the tank and equipped with a manual drain valve that drains into the primary tank. For tanks with a remote fill connection, a portable spill container shall be allowed.

**32.4.2.9.6.9 Tank openings.** Tank openings in protected above-ground tanks shall be through the top only.

**32.4.2.9.6.10 Antisiphon devices.** Approved antisiphon devices shall be installed in each external pipe connected to the protected above-ground tank when the pipe extends below the level of the top of the tank.

**32.4.2.10 Drainage and diking.** The area surrounding a tank or group of tanks shall be provided with drainage control or shall be diked to prevent accidental discharge of liquid from endangering adjacent tanks, adjoining property or reaching waterways.

**Exceptions:**

1. The building code official is authorized to alter or waive these requirements based on a technical report which demonstrates that such tank or group of tanks does not constitute a hazard to other tanks, waterways or adjoining property, after consideration of special features such as topographical conditions, nature of occupancy and proximity to buildings on the same or adjacent property, capacity, and construction of proposed tanks and character of liquids to be stored, and nature and quantity of private and public fire protection provided.
2. Drainage control and diking is not required for listed secondary containment tanks.

**32.4.2.10.1 Volumetric capacity.** The volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area. The capacity of the diked area enclosing more than one tank shall be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike.

**32.4.2.10.2 Diked areas containing two or more tanks.** Diked areas containing two or more tanks shall be subdivided in accordance with NFPA 30.

**32.4.2.10.3 Protection of piping from exposure fires.** Piping shall not pass through adjacent diked areas or impounding basins, unless provided with a sealed sleeve or otherwise protected from exposure to fire.

**32.4.2.10.4 Combustible materials in diked areas.** Diked areas shall be kept free from combustible materials, drums and barrels.

**32.4.2.10.5 Equipment, controls and piping in diked areas.** Pumps, manifolds and fire protection equipment or controls shall not be located within diked areas or drainage basins or in a location where such equipment and controls would be endangered by fire in the diked area or drainage basin. Piping above ground shall be minimized and located as close as practical to the shell of the tank in diked areas or drainage basins.

**Exceptions:**

1. Pumps, manifolds and piping integral to the tanks or equipment being served which is protected by intermediate diking, berms, drainage or fire protection such as water spray, monitors or resistive coating.
2. Fire protection equipment or controls which are appurtenances to the tanks or equipment being protected, such as foam chambers or foam piping and water or foam monitors and hydrants, or hand and wheeled extinguishers.

**32.4.2.11 Underground tanks.** Underground storage of flammable and combustible liquids in tanks shall comply with Section 32.4.2 and Sections 32.4.2.11.1 through 32.4.2.11.5.2.

**32.4.2.11.1 Contents.** Underground tanks shall not contain petroleum products containing mixtures of a nonpetroleum nature, such as ethanol or methanol blends, without evidence of compatibility.

- 32.4.2.11.2 Location.** Flammable and combustible liquid storage tanks located underground, either outside or under buildings, shall be in accordance with all of the following:
1. Tanks shall be located with respect to existing foundations and supports such that the loads carried by the latter cannot be transmitted to the tank.
  2. The distance from any part of a tank storing liquids to the nearest wall of a basement, pit, cellar, or lot line shall not be less than 900 mm.
  3. A minimum distance of 0.3 m, shell to shell, shall be maintained between underground tanks.
- 32.4.2.11.3 Depth and cover.** Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks shall be set on firm foundations and surrounded with at least 150 mm of noncorrosive inert material, such as clean sand.
- 32.4.2.11.4 Overfill protection and prevention systems.** Fill pipes shall be equipped with a spill container and an overfill prevention system in accordance with NFPA 30.
- 32.4.2.11.5 Leak prevention.** Leak prevention for under ground tanks shall comply with Sections 32.4.2.11.5.1 and 32.4.2.11.5.2.
- 32.4.2.11.5.1 Inventory control.** Daily inventory records shall be maintained for underground storage tank systems.
- 32.4.2.11.5.2 Leak detection.** Underground storage tank systems shall be provided with an approved method of leak detection from any component of the system that is designed and installed in accordance with NFPA 30.
- 32.4.2.12 Testing.** Tank testing shall comply with Sections 32.4.2.12.1 and 32.4.2.12.2.
- 32.4.2.12.1 Acceptance testing.** Prior to being placed into service, tanks shall be tested in accordance with Section 2.4 of NFPA 30.
- 32.4.2.12.2 Testing of underground tanks.** Before being covered or placed in use, tanks and piping connected to underground tanks shall be tested for tightness in the presence of the building code official. Piping shall be tested in accordance with Section 32.3.6.3. The system shall not be covered until it has been approved.
- 32.4.2.13 Abandonment and status of tanks.** Tanks taken out of service shall be removed in accordance with Section 32.4.2.14, or safeguarded in accordance with Sections 32.4.2.13.1 through 32.4.2.13.2.3 and API 1604.
- 32.4.2.13.1 Underground tanks.** Underground tanks taken out of service shall comply with Sections 32.4.2.13.1.1 through 32.4.2.13.1.5.
- 32.4.2.13.1.1 Temporarily out of service.** Underground tanks temporarily out of service shall have the fill line, gauge opening, vapor return and pump connection secure against tampering. Vent lines shall remain open and be maintained in accordance with Sections 32.4.2.7.3 and 32.4.2.7.4.
- 32.4.2.13.1.2 Out of service for 90 days.** Underground tanks not used for a period of 90 days shall be safeguarded in accordance with all the following or be removed in accordance with Section 32.4.2.14:
1. Flammable or combustible liquids shall be removed from the tank.
  2. All piping, including fill line, gauge opening, vapor return and pump connection, shall be capped or plugged and secured from tampering.
  3. Vent lines shall remain open and be maintained in accordance with Sections 32.4.2.7.3 and 32.4.2.7.4.
- 32.4.2.13.1.3 Out of service for 1 year.** Underground tanks that have been out of service for a period of 1 year shall be removed from the ground in accordance with Section 32.4.2.14 or abandoned in place in accordance with Section 32.4.2.13.1.4.
- 32.4.2.13.1.4 Tanks abandoned in place.** Tanks abandoned in place shall be abandoned as follows:
1. Flammable and combustible liquids shall be removed from the tank and connected piping.

2. The suction, inlet, gauge, vapor return and vapor lines shall be disconnected.

3. The tank shall be filled completely with an approved, inert solid material.

**Exception:** Residential heating oil tanks of 4,164 L or less, provided the fill line is permanently capped or plugged, below grade, to prevent refilling of the tank.

4. Remaining underground piping shall be capped or plugged.

5. A record of tank size, location and date of abandonment shall be retained.

**32.4.2.13.1.5 Reinstallation of underground tanks.** Tanks which are to be reinstalled for flammable or combustible liquid service shall be in accordance with this chapter, ASME Boiler and Pressure Vessel Code (Section VIII), API 12-P, API 1615, UL 58 and UL 1316.

**32.4.2.13.2 Above-ground tanks.** Above-ground tanks taken out of service shall comply with Sections 32.4.2.13.2.1 through 32.4.2.13.2.3.

**32.4.2.13.2.1 Temporarily out of service.** Above-ground tanks temporarily out of service shall have all connecting lines isolated from the tank and be secured against tampering.

**Exception:** In-place fire protection (foam) system lines.

**32.4.2.13.2.2 Out of service for 90 days.** Above-ground tanks not used for a period of 90 days shall be safeguarded in accordance with Section 32.4.2.13.1.2 or removed in accordance with Section 32.4.2.14.

**Exceptions:**

1. Tanks and containers connected to oil burners that are not in use during the warm season of the year or are used as a backup heating system to gas.

2. In-place, active fire protection (foam) system lines.

**32.4.2.13.2.3 Out of service for 1 year.** Above-ground tanks that have been out of service for a period of 1 year shall be removed in accordance with Section 32.4.2.14.

**Exception:** Tanks within operating facilities.

**32.4.2.14 Removal and disposal of tanks.** Removal and disposal of tanks shall comply with Sections 32.4.2.14.1 and 32.4.2.14.2.

**32.4.2.14.1 Removal.** Removal of above-ground and underground tanks shall be in accordance with all of the following:

1. Flammable and combustible liquids shall be removed from the tank and connecting piping.

2. Piping at tank openings which is not to be used further shall be disconnected.

3. Piping shall be removed from the ground.

**Exception:** Piping is allowed to be abandoned in place where the building code official determines that removal is not practical. Abandoned piping shall be capped and safeguarded as required by the building code official.

4. Tank openings shall be capped or plugged, leaving a 3.2 mm to 6.4 mm opening for pressure equalization.

5. Tanks shall be purged of vapor and inserted prior to removal.

**32.4.2.14.2 Disposal.** Tanks shall be disposed of in accordance with the local regulations.

**32.4.3 Container and portable tank storage.** Storage of flammable and combustible liquids in closed containers that do not exceed 227 L in individual capacity and portable tanks that do not exceed 2,498 L in individual capacity, and limited transfers incidental thereto, shall comply with this section.

**32.4.3.1 Design, construction and capacity of containers and portable tanks.** The design, construction and capacity of containers for the storage of flammable and combustible liquids shall be in accordance with this section and Section 4.2 of NFPA 30.

**32.4.3.1.1 Approved containers.** Only approved containers and portable tanks shall be used.

**32.4.3.2 Liquid storage cabinets.** Where other sections of these code requirements require that liquid containers be stored in storage cabinets, such cabinets and storage shall be in accordance with Sections 32.4.3.2.1 through 32.4.3.2.3.

- 32.4.3.2.1 Design and construction of storage cabinets.** Design and construction of liquid storage cabinets shall be in accordance with this section.
- 32.4.3.2.1.1 Materials.** Cabinets shall be listed in accordance with UL 1275, or constructed of approved wood or metal in accordance with the following:
1. Unlisted metal cabinets shall be constructed of steel having a thickness of not less than 1.12 mm (18 gage). The cabinet, including the door, shall be double walled with 38 mm airspace between the walls. Joints shall be riveted or welded and shall be tight fitting.
  2. Unlisted wooden cabinets, including doors, shall be constructed of not less than 25 mm exterior grade plywood. Joints shall be rabbeted and shall be fastened in two directions with wood screws. Door hinges shall be of steel or brass. Cabinets shall be painted with an intumescent-type paint.
- 32.4.3.2.1.2 Labeling.** Cabinets shall be provided with a conspicuous label in red letters on contrasting background which reads: FLAMMABLE – KEEP FIRE AWAY.
- 32.4.3.2.1.3 Doors.** Doors shall be well fitted, self-closing and equipped with a three-point latch.
- 32.4.3.2.1.4 Bottom.** The bottom of the cabinet shall be liquid tight to a height of at least 50 mm.
- 32.4.3.2.2 Capacity.** The combined total quantity of liquids in a cabinet shall not exceed 454 L.
- 32.4.3.2.3 Number of storage cabinets.** Not more than three storage cabinets shall be located in a single fire area, except that in a Group F occupancy, additional cabinets are allowed to be located in the same fire area if the additional cabinets (or groups of up to three cabinets) are separated from other cabinets or groups of cabinets by at least 30.5 m.
- 32.4.3.3 Indoor storage.** Storage of flammable and combustible liquids inside buildings in containers and portable tanks shall be in accordance with this section.
- Exceptions:**
1. Liquids in the fuel tanks of motor vehicles, aircraft, boats or portable or stationary engines.
- 32.4.3.3.1 Portable fire extinguishers.** Approved portable fire extinguishers shall be provided in accordance with specific sections of this chapter and Section 7.6.
- 32.4.3.3.2 Incompatible materials.** Materials that will react with water or other liquids to produce a hazard shall not be stored in the same room with flammable and combustible liquids in accordance with Section 25.3.9.8.
- 32.4.3.3.3 Clear means of egress.** Storage of any liquids, including stock for sale, shall not be stored near or be allowed to obstruct physically the route of egress.
- 32.4.3.3.4 Empty containers or portable tank storage.** The storage of empty tanks and containers previously used for the storage of flammable or combustible liquids, unless free from explosive vapors, shall be stored as required for filled containers and portable tanks. Portable tanks and containers, when emptied, shall have the covers or plugs immediately replaced in openings.
- 32.4.3.3.5 Shelf storage.** Shelving shall be of approved construction, adequately braced and anchored. Seismic requirements shall be in accordance with the SBC 301.
- 32.4.3.3.5.1 Use of wood.** Wood of at least 25 mm nominal thickness is allowed to be used as shelving, racks, dunnage, scuffboards, floor overlay and similar installations.
- 32.4.3.3.5.2 Displacement protection.** Shelves shall be of sufficient depth and provided with a lip or guard to prevent individual containers from being displaced.
- Exception:** Shelves in storage cabinets or on laboratory furniture specifically designed for such use.
- 32.4.3.3.5.3 Orderly storage.** Shelf storage of flammable and combustible liquids shall be maintained in an orderly manner.
- 32.4.3.3.6 Rack storage.** Where storage on racks is allowed elsewhere in these code requirements, a minimum 1.2 m wide aisle shall be provided between adjacent rack sections and any adjacent storage of liquids. Main aisles shall be a minimum of 2.4 m wide.



- 32.4.3.3.7 Pile or palletized storage.** Solid pile and palletized storage in liquid warehouses shall be arranged so that piles are separated from each other by at least 1.2 m. Aisles shall be provided and arranged so that no container or portable tank is more than 6.1 m from an aisle. Main aisles shall be a minimum of 2.4 m wide.
- 32.4.3.3.8 Limited combustible storage.** Limited quantities of combustible commodities are allowed to be stored in liquid storage areas where the ordinary combustibles, other than those used for packaging the liquids, are separated from the liquids in storage by a minimum of 2.4 m horizontally, either by open aisles or by open racks, and where protection is provided in accordance with Chapter 7.
- 32.4.3.3.9 Idle combustible pallets.** Storage of empty or idle combustible pallets inside an unprotected liquid storage area shall be limited to a maximum pile size of 232 m<sup>2</sup> and to a maximum storage height of 1.8 m. Storage of empty or idle combustible pallets inside a protected liquid storage area shall comply with NFPA 231. Pallet storage shall be separated from liquid storage by aisles that are at least 2.4 m.
- 32.4.3.3.10 Containers in piles.** Containers in piles shall be stacked in such a manner as to provide stability and to prevent excessive stress on container walls. Portable tanks stored more than one tier high shall be designed to nest securely, without dunnage. Material-handling equipment shall be suitable to handle containers and tanks safely at the upper tier level.
- 32.4.3.4 Quantity limits for storage.** Liquid storage quantity limitations shall comply with Sections 32.4.3.4.1 through 32.4.3.4.4.
- 32.4.3.4.1 Maximum allowable quantity per control area.** For occupancies other than Group M wholesale and retail sales uses, indoor storage of flammable and combustible liquids shall not exceed the maximum allowable quantities per control area indicated in Table 25.3.1.1(1) and shall not exceed the additional limitations set forth in this section. For Group M occupancy wholesale and retail sales uses, indoor storage of flammable and combustible liquids shall not exceed the maximum allowable quantities per control area indicated in Table 32.4.3.4.1. Storage of hazardous production material flammable and combustible liquids in Group H-5 occupancies shall be in accordance with Chapter 16.

**TABLE 32.4.3.4.1  
MAXIMUM ALLOWABLE QUANTITY OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN  
WHOLESALE AND RETAIL SALES USES PER CONTROL AREA<sup>a</sup>**

TYPE OF LIQUID	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (litres)		
	Sprinklered <sup>b</sup> per footnote densities and arrangements	Sprinklered per Tables 32.4.3.6.3(4) through 32.4.3.6.3(8) and Table 32.4.3.7.5.1	Nonsprinklered
Class IA	227	227	114
Class IB, IC, II and IIIA	28,388 <sup>c</sup>	56,775 <sup>c</sup>	6,056
Class IIIB	Unlimited	Unlimited	49,962

- a. Control areas shall be separated from each other by not less than a 1 hour fire barrier wall.
- b. To be considered as sprinklered, a building shall be equipped throughout with an approved automatic sprinkler system with a design providing minimum densities as follows:
  1. For uncartoned commodities on shelves 1.8 m or less in height where the ceiling height does not exceed 5.5 m, quantities are those permitted with a minimum sprinkler design density of Ordinary Hazard Group 2.
  2. For cartoned, palletized or racked commodities where storage is 1.4 m or less in height and where the ceiling height does not exceed 5.5 m, quantities are those permitted with a minimum sprinkler design density of 8.6 L/min/m<sup>2</sup> over the most remote 139 m<sup>2</sup> area.
- c. Where wholesale and retail sales or storage areas exceed 4645 m<sup>2</sup> in area, the maximum allowable quantities are allowed to be increased by 2 percent for each 93 m<sup>2</sup> of area in excess of 4,645 m<sup>2</sup>, up to a maximum of 100 percent of the table amounts. A control area separation is not required. The cumulative amounts, including amounts attained by having an additional control area, shall not exceed 11,550 litres.

- 32.4.3.4.2 Occupancy quantity limits.** The following limits for quantities of stored flammable or combustible liquids shall not be exceeded:
1. Group A occupancies: Quantities in Group A occupancies shall not exceed that necessary for demonstration, treatment, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
  2. Group B occupancies: Quantities in drinking, dining, office and school uses within Group B occupancies shall not exceed that necessary for demonstration, treatment, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
  3. Group E occupancies: Quantities in Group E occupancies shall not exceed that necessary for demonstration, treatment, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
  4. Group F occupancies: Quantities in dining, office, and school uses within Group F occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
  5. Group I occupancies: Quantities in Group I occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
  6. Group M occupancies: Quantities in dining, office, and school uses within Group M occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1). The maximum allowable quantities for storage in wholesale and retail sales areas shall be in accordance with Section 32.4.3.4.1.
  7. Group R occupancies: Quantities in Group R occupancies shall not exceed that necessary for maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
  8. Group S occupancies: Quantities in dining and office uses within Group S occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
- 32.4.3.4.3 Quantities exceeding limits for control areas.** Quantities exceeding those allowed in control areas set forth in Section 32.4.3.4.1 shall be in liquid storage rooms or liquid storage warehouses in accordance with Sections 32.4.3.7 and 32.4.3.8.
- 32.4.3.4.4 Liquids for maintenance and operation of equipment.** In all occupancies, quantities of flammable and combustible liquids in excess of 38 L used for maintenance purposes and the operation of equipment shall be stored in liquid storage cabinets in accordance with Section 32.4.3.2. Quantities not exceeding 38 L are allowed to be stored outside of a cabinet when in approved containers located in private garages or other approved locations.
- 32.4.3.5 Storage in control areas.** Storage of flammable and combustible liquids in control areas shall be in accordance with Sections 32.4.3.5.1 through 32.4.3.5.4.
- 32.4.3.5.1 Basement storage.** Class I liquids shall not be permitted in basement areas. Class II and IIIA liquids shall be allowed to be stored in basements provided that automatic suppression and other fire protection is provided in accordance with Chapter 7.
- 32.4.3.5.2 Storage pile heights.** Containers having less than a 114 L capacity which contain Class I or II liquids shall not be stacked more than 900 mm or two containers high, whichever is greater, unless stacked on fixed shelving or otherwise satisfactorily secured. Containers of Class I or II liquids having a capacity of 114 L or more shall not be stored more than one container high. Containers shall be stored in an upright position.

- 32.4.3.5.3 Storage distance from ceilings and roofs.** Piles of containers or portable tanks shall not be stored closer than 900 mm to the nearest beam, chord, girder or other obstruction, and shall be 900 mm below sprinkler deflectors or discharge orifices of water spray or other overhead fire protection system.
- 32.4.3.5.4 Combustible materials.** In areas that are inaccessible to the public, Class I, II and IIIA liquids shall not be stored in the same pile or rack section as ordinary combustible commodities unless such materials are packaged together as kits.
- 32.4.3.6 Wholesale and retail sales uses.** Flammable and combustible liquids in Group M occupancy wholesale and retail sales uses shall be in accordance with Sections 32.4.3.6.1 through 32.4.3.6.5, or NFPA 30 Sections 4.4.3.3, 4.5.6.7, 4.8.2, Tables 4.8.2(a) through (f), and Figures 4.8.2(a) through (d).
- 32.4.3.6.1 Container type.** Containers for Class I liquids shall be metal.  
**Exception:** In sprinklered buildings, an aggregate quantity of 454 L of water-miscible Class IB and Class IC liquids is allowed in nonmetallic containers, each having a capacity of 0.473 L or less.
- 32.4.3.6.2 Container capacity.** Containers for Class I liquids shall not exceed a capacity of 19 L.  
**Exception:** Metal containers not exceeding 208 L are permitted to store up to 908 L of the maximum allowable quantity per control area of Class IB and IC liquids in a control area. The building shall be equipped throughout with an approved automatic sprinkler system in accordance with Table 32.4.3.4.1. The containers shall be provided with plastic caps without cap seals and shall be stored upright. Containers shall not be stacked or stored in racks and shall not be located in areas accessible to the public.
- 32.4.3.6.3 Fire protection and storage arrangements.** Fire protection and container storage arrangements shall be in accordance with Table 32.4.3.6.3(1) or the following:
1. Storage on shelves shall not exceed 1.8 m in height, and shelving shall be metal.
  2. Storage on pallets or in piles greater than 1.4 m in height, or where the ceiling exceeds 5.5 m in height, shall be protected in accordance with Table 32.4.3.6.3(4), and the storage heights and arrangements shall be limited to those specified in Table 32.4.3.6.3(2).
  3. Storage on racks greater than 1.4 m in height, or where the ceiling exceeds 5.5 m in height shall be protected in accordance with Tables 32.4.3.6.3(5), 32.4.3.6.3(6), and 32.4.3.6.3(7) as appropriate, and the storage heights and arrangements shall be limited to those specified in Table 32.4.3.6.3(3).
- Combustible commodities shall not be stored above flammable and combustible liquids.

**TABLE 32.4.3.6.3(1)**  
**MAXIMUM STORAGE HEIGHT IN CONTROL AREA**

<b>TYPE OF LIQUID</b>	<b>NONSPRINKLERED AREA (m)</b>	<b>SPRINKLERED AREA (m)</b>	<b>SPRINKLERED<sup>a</sup> WITH IN-RACK PROTECTION (m)</b>
Flammable liquids:			
Class 1A	1.2	1.2	1.2
Class 1B	1.2	2.4	3.7
Class 1C	1.2	2.4	3.7
Combustible liquids:			
Class II	1.8	2.4	3.7
Class IIIA	2.4	3.7	4.9
Class IIIB	2.4	3.7	6.1

a. In-rack protection shall be in accordance with Table 32.4.3.6.3(5), 32.4.3.6.3 (6) or 32.4.3.6.3 (7).

**TABLE 32.4.3.6.3(2)**  
**STORAGE ARRANGEMENTS FOR PALLETIZED OR SOLID-PILE STORAGE IN LIQUID**  
**STORAGE ROOMS AND WAREHOUSES**

CLASS	STORAGE LEVEL	MAXIMUM STORAGE HEIGHT			MAXIMUM QUANTITY PER PILE (litres)		MAXIMUM QUANTITY PER ROOM <sup>a</sup> (litres)	
		Drums	Containers <sup>b</sup> (meter)	Portable tanks (meter)	Containers	Portable tanks	Containers	Portable tanks
IA	Ground floor	1	1.5	Not Allowed	11,355	Not Allowed	45,420	Not Allowed
	Upper floors	1	1.5	Not Allowed	7,570	Not Allowed	30,280	Not Allowed
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
IB	Ground floor	1	2	2.1	18,925	75,700	56,775	151,400
	Upper floors	1	2	2.1	11,355	37,850	45,420	75,700
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
IC	Ground floor	1	2 <sup>c</sup>	2.1	18,925	75,700	56,775	151,400
	Upper floors	1	2 <sup>c</sup>	2.1	11,355	37,850	45,420	75,700
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
II	Ground floor	3	3	4.3	37,850	151,400	94,625	302,800
	Upper floors	3	3	4.3	37,850	151,400	94,625	302,800
	Basements	1	1.5	2.13	28,388	75,700	28,388	75,700
III	Ground floor	5	6.1	4.3	56,775	227,100	189,250	378,500
	Upper floors	5	6.1	4.3	56,775	227,100	189,250	378,500
	Basements	3	3	2.1	37,850	75,700	94,625	151,400

- a. See Section 32.4.3.8.1 for unlimited quantities in liquid storage warehouses.  
b. Storage heights are allowed to be increased for Class IB, IC, II and III liquids in metal containers having a capacity of 19 litres or less where an automatic AFFF-water protection system is provided in accordance with Table 32.4.3.7.5.1.  
c. These height limitations are allowed to be increased to 3 m for containers having a capacity of 19 litres or less.

**TABLE 32.4.3.6.3(3)**  
**STORAGE ARRANGEMENTS FOR RACK STORAGE IN LIQUID STORAGE ROOMS**  
**AND WAREHOUSES**

CLASS	TYPE RACK	STORAGE LEVEL	MAXIMUM STORAGE HEIGHT (meter)	MAXIMUM QUANTITY PER ROOM (litres)
			Containers	Containers
IA	Double row or Single row	Ground floor	7.6	28,388
		Upper floors	4.6	17,033
		Basements	Not Allowed	Not Allowed
IB IC	Double row or Single row	Ground floor	7.6	56,775
		Upper floors	4.6	34,065
		Basements	Not Allowed	Not Allowed
II	Double row or Single row	Ground floor	7.6	90,840
		Upper floors	7.6	90,840
		Basements	4.6	34,065
III	Multirow Double room Single row	Ground floor	12.2	181,680
		Upper floors	6.1	181,680
		Basements	6.1	90,840

TABLE 32.4.3.6.3(4)  
AUTOMATIC SPRINKLER PROTECTION FOR SOLID-PILE AND PALLETIZED STORAGE OF LIQUIDS IN CONTAINERS AND PORTABLE TANKS<sup>a</sup>

STORAGE CONDITIONS		CEILING SPRINKLER DESIGN AND DEMAND				MINIMUM HOSE STREAM DEMAND (L/min)	MINIMUM DURATION SPRINKLERS AND HOSE STREAMS (hours)
Class liquid	Container size and arrangement	Density (L/min/m <sup>2</sup> )	Area (square meter)		Maximum spacing (square meter)		
			High-temperature sprinklers	Ordinary temperature sprinklers			
IA	19 litres or less, with or without cartons, palletized or solid pile <sup>b</sup>	12.23	279	465	9.3	2,839	2
	Containers greater than 19 litres, on end or side, palletized or solid pile	24.45	465	743	7.4	2,839	
IB, IC and II	19 litres or less, with or without cartons, palletized or solid pile <sup>b</sup>	12.23	279	465	9.3	1,893	2
	Containers greater than 19 litres on pallets or solid pile, one high	10.19	465	743	9.3		
II	Containers greater than 19 litres on pallets or solid pile, more than one high, on end or side	24.45	465	743	7.4	2,839	2
IB, IC and II	Portable tanks, one high	12.23	279	465	9.3	1,893	2
II	Portable tanks, two high	24.45	465	743	7.4	2,839	2
III	19 litres or less, with or without cartons, palletized or solid pile	10.19	279	465	11	1,893	1
	Containers greater than 19 litres on pallets or solid pile, on end or sides, up to three high	10.19	279	465	11	1,893	1
III	Containers greater than 19 litres, on pallets or solid pile, on end or sides, up to 5.5 m high	14.26	279	465	9.3	2,839	2
	Portable tanks, one high	10.19	279	465	11	1,893	1
	Portable tanks, two high	20.38	279	465	7.4	2,839	2

a. The design area contemplates the use of Class II standpipe systems. Where Class I standpipe systems are used, the area of application shall be increased by 30 percent without revising density.  
b. For storage heights above 1.2 m or ceiling heights greater than 5.5 m, an approved engineering design shall be provided in accordance with SBC 100.

TABLE 32.4.3.6.3(5)

AUTOMATIC SPRINKLER PROTECTION REQUIREMENTS FOR RACK STORAGE OF LIQUIDS IN CONTAINERS OF 19 LITRES CAPACITY OR LESS WITH OR WITHOUT CARTONS ON CONVENTIONAL WOOD PALLETS<sup>a</sup>

CLASS LIQUID	CEILING SPRINKLER DESIGN AND DEMAND			IN-RACK SPRINKLER ARRANGEMENT AND DEMAND					MINIMUM HOSE STREAM DEMAND (L/min)	MINIMUM DURATION SPRINKLER AND HOSE STREAM (hours)
	Density (L/min/m <sup>2</sup> )	Area (square meter)		Maximum spacing	Racks up to 2.7 m deep	Racks more than 2.7 m to 3.7 m deep	207 kPa (standard orifice)	Number of sprinklers operating		
		High-temperature sprinklers	Ordinary temperature sprinklers				97 kPa (large orifice)			
I (maximum 7.6-m height) Option 1	16.3	279	465	7.4 m <sup>2</sup> /head	1. Ordinary temperature, quick-response sprinklers, maximum 2.5 m horizontal spacing 2. One line sprinklers above each level of storage 3. Locate in longitudinal flue space, staggered vertical 4. Shields required where multilevel	1. Ordinary temperature, quick-response sprinklers, maximum 2.5 m horizontal spacing 2. One line sprinklers above each level of storage 3. Locate in transverse flue spaces, staggered vertical and within 508 mm of aisle 4. Shields required where multilevel	207 kPa (12.7-mm orifice)	1. Eight sprinklers, if only one level 2. Six sprinklers each on two levels if only two levels 3. Six sprinklers each on top three levels, if three or more levels 4. Hydraulically most remote	2,839	2
I (maximum 7.6-m height) Option 2	22.41	186 <sup>b</sup>	Not applicable	9.3 m <sup>2</sup> /head	1. Ordinary temperature, quick-response sprinklers, maximum 2.5 m horizontal spacing 2. See 2 above 3. See 3 above 4. See 4 above	1. Ordinary temperature, quick-response sprinklers, maximum 2.5 m horizontal spacing 2. See 2 above 3. See 3 above 4. See 4 above	97 kPa (13.5-mm orifice)	See 1 through 4 above	1,893	2
I and II (maximum 4.3-m storage height) (maximum three tiers)	22.41 <sup>c</sup>	186 <sup>b,d</sup>	Not applicable	9.3 m <sup>2</sup> /head	Not applicable None for maximum 1.8 m-deep racks	Not applicable	Not applicable	Not applicable	1,893	2
II (maximum 7.6-m height)	12.22	279	465	9.3 m <sup>2</sup> /head	1. Ordinary temperature sprinklers 2.4 m apart horizontally 2. One line sprinklers between levels at nearest 3 m vertical intervals 3. Locate in longitudinal flue space, staggered vertical 4. Shields required where multilevel	1. Ordinary temperature sprinklers 2.4 m apart horizontally 2. Two lines between levels at nearest 3 m vertical intervals 3. Locate in transverse flue spaces, staggered vertical and within 508 mm of aisle 4. Shields required where multilevel	207 kPa	Hydraulically most remote—six sprinklers at each level, up to a maximum of three levels	2,839	2
III (12.2-m height)	10.2	279	465	11 m <sup>2</sup> /head	Same as for Class II liquids	Same as for Class II liquids	207 kPa	Same as for Class II liquids	1,893	2

a. The design area contemplates the use of Class II standpipe systems. Where Class I standpipe systems are used, the area of application shall be increased by 30 percent without revising density.  
b. Using listed or approved extra-large orifice, high-temperature quick-response or standard element sprinklers under a maximum 5.5 m ceiling with minimum 2.3 m aisles.  
c. For friction lid cans and other metal containers equipped with plastic nozzles or caps, the density shall be increased to 26.49 L/min/m<sup>2</sup> using listed or approved extra-large orifice, high-temperature quick-response sprinklers.  
d. Using listed or approved extra-large orifice, high-temperature quick-response or standard element sprinklers under a maximum 5.5 m ceiling with minimum 2.3 m aisles and metal containers.

TABLE 32.4.3.6.3(6)

AUTOMATIC SPRINKLER PROTECTION REQUIREMENTS FOR RACK STORAGE OF LIQUIDS IN CONTAINERS GREATER THAN 19 LITRES CAPACITY<sup>a</sup>

CLASS LIQUID	CEILING SPRINKLER DESIGN AND DEMAND			IN-RACK SPRINKLER ARRANGEMENT AND DEMAND					MINIMUM HOSE STREAM DEMAND (L/min)	MINIMUM DURATION SPRINKLER AND HOSE STREAM (hours)
	Density (L/min/m <sup>2</sup> )	Area (square meter)		Maximum spacing	On-side storage racks up to 2.7 m deep racks	On-side storage (on pallets) up to 2.7 m deep racks	Minimum nozzle pressure	Number of sprinklers operating		
		High-temperature sprinklers	Ordinary temperature sprinklers							
IA (maximum 7.6-m height)	24.45	279	465	7.4 m <sup>2</sup> /head	1. Ordinary temperature sprinklers 2.4 m apart horizontally 2. One line sprinklers above each tier of storage 3. Locate in longitudinal flue space, staggered vertical 4. Shields required where multilevel	1. Ordinary temperature sprinklers 2.4 m apart horizontally 2. One line sprinklers above each tier of storage 3. Locate in longitudinal flue space, staggered vertical 4. Shields required where multilevel	207kPa	Hydraulically most remote—six sprinklers at each level	3,785	2
IB, IC and II (maximum 7.6-m height)	24.45	279	465	9.3 m <sup>2</sup> /head	1. See 1 above 2. One line sprinklers every three tiers of storage 3. See 3 above 4. See 4 above	1. See 1 above 2. See 2 above 3. See 3 above 4. See 4 above	207kPa	Hydraulically most remote—six sprinklers at each level	2,839	2
III (maximum 12.2-m height )	10.2	279	465	11 m <sup>2</sup> /head	1. See 1 above 2. One line sprinklers every sixth level (maximum) 3. See 3 above 4. See 4 above	1. See 1 above 2. One line sprinklers every third level (maximum) 3. See 3 above 4. See 4 above	103kPa	Hydraulically most remote—six sprinklers at each level	1,893	1

a. The design area contemplates the use of Class II standpipe systems. Where Class I standpipe systems are used, the area of application shall be increased by 30 percent without revising density.

TABLE 32.4.3.6.3(7)  
AUTOMATIC AFFF WATER PROTECTION REQUIREMENTS FOR RACK STORAGE OF LIQUIDS IN CONTAINERS GREATER THAN 19 LITRES  
CAPACITY<sup>a,b</sup>

CLASS LIQUID	CEILING SPRINKLER DESIGN AND DEMAND		IN-RACK SPRINKLER ARRANGEMENT AND DEMAND <sup>c</sup>				DURATION AFFF SUPPLY (minimum)	DURATION WATER SUPPLY (hours)	
	Density (L/min/m <sup>2</sup> )	Area (square meter)	On-end storage of drums on pallets, up to 7.6 m	Minimum nozzle pressure (kPa)	Number of sprinklers operating	Hose stream demand <sup>d</sup> (L/min)			
		High-temperature sprinklers							Ordinary temperature sprinklers
IA, IB, IC and II	12.2	139	232	1. Ordinary temperature sprinkler up to 3 m apart horizontally 2. One line sprinklers above each level of storage 3. Locate in longitudinal flue space, staggered vertically 4. Shields required for multilevel	207 kPa	Three sprinklers per level	1,893	15	2

- a. System shall be a closed-head wet system with approved devices for proportioning aqueous film-forming foam.
- b. Except as modified herein, in-rack sprinklers shall be installed in accordance with NFPA 231C.
- c. The height of storage shall not exceed 7.6 m.
- d. Hose stream demand includes 40 mm (1.5 inch) inside hand hose, when required.



**TABLE 32.4.3.6.3(8)**  
**AUTOMATIC SPRINKLER PROTECTION REQUIREMENTS FOR CLASS I LIQUID STORAGE OF 3.8 LITRES CAPACITY OR LESS WITH UNCARTONED OR CASE-CUT SHELF DISPLAY UP TO 2 M, AND PALLETIZED STORAGE ABOVE IN A DOUBLE-ROW RACK ARRAY<sup>a</sup>**

STORAGE HEIGHT	CEILING SPRINKLER DESIGN AND DEMAND				IN-RACK SPRINKLER ARRANGEMENT AND DEMAND				MINIMUM HOSE STREAM DEMAND (L/min)	MINIMUM DURATION SPRINKLERS AND HOSE STREAM (hours)
	Density (L/min/m <sup>2</sup> )	Area (square meter)		Maximum spacing	Racks up to 2.7 m deep	Racks 2.7 to 3.7 meter	Minimum nozzle pressure	Number of sprinklers operating		
		High temperature	Ordinary temperature							
Maximum 6 meter storage height	24.5	186 <sup>b</sup>	Not Applicable	9.3 m <sup>2</sup> /head	1. Ordinary temperature, quick-response sprinklers, maximum 2.5 m horizontal spacing 2. One line of sprinklers at the 1.8 m level and the 3.5 m level of storage 3. Locate in longitudinal flue space, staggered vertical 4. Shields required where multilevel	Not Applicable	207 kPa (standard orifice) or 97 kPa (large orifice)	1. Six sprinklers each on two levels 2. Hydraulically most remote 12 sprinklers	1,893	2

a. This table shall not apply to racks with solid shelves.

b. Using extra-large orifice sprinklers under a ceiling 9.1 m or less in height. Minimum aisle width is 2.3 m.

- 32.4.3.6.4 Warning for containers.** All cans, containers and vessels containing flammable liquids or flammable liquid compounds or mixtures offered for sale shall be provided with a warning indicator, painted or printed on the container and stating that the liquid is flammable, and shall be kept away from heat and an open flame.
- 32.4.3.6.5 Storage plan.** When required by fire the code official, aisle and storage plans shall be submitted in accordance with Chapter 25.
- 32.4.3.7 Liquid storage rooms.** Liquid storage rooms shall comply with Sections 32.4.3.7.1 through 32.4.3.7.5.2.
- 32.4.3.7.1 General.** Quantities of liquids exceeding those set forth in Section 32.4.3.4.1 for storage in control areas shall be stored in a liquid storage room complying with this section and constructed and separated as required by the SBC.
- 32.4.3.7.2 Quantities and arrangement of storage.** The quantity limits and storage arrangements in liquid storage rooms shall be in accordance with Tables 32.4.3.6.3(2) and 32.4.3.6.3(3) and Sections 32.4.3.7.2.1 through 32.4.3.7.2.3.
- 32.4.3.7.2.1 Mixed storage.** Where two or more classes of liquids are stored in a pile or rack section:
1. The quantity in that pile or rack shall not exceed the smallest of the maximum quantities for the classes of liquids stored in accordance with Table 32.4.3.6.3(2) or 32.4.3.6.3(3); and
  2. The height of storage in that pile or rack shall not exceed the smallest of the maximum heights for the classes of liquids stored in accordance with Table 32.4.3.6.3(2) or 32.4.3.6.3(3).
- 32.4.3.7.2.2 Separation and aisles.** Piles shall be separated from each other by at least 1.2 m aisles. Aisles shall be provided so that all containers are 6.1 m or less from an aisle. Where the storage of liquids is on racks, a minimum 1.2 m wide aisle shall be provided between adjacent rows of racks and adjacent storage of liquids. Main aisles shall be a minimum of 2.4 m wide.  
Additional aisles shall be provided for access to doors, required windows and ventilation openings, standpipe connections, mechanical equipment and switches. Such aisles shall be at least 900 mm in width, unless greater widths are required for separation of piles or racks, in which case the greater width shall be provided.
- 32.4.3.7.2.3 Stabilizing and supports.** Containers and piles shall be separated by pallets or dunnage to provide stability and to prevent excessive stress to container walls. Portable tanks stored over one tier shall be designed to nest securely without dunnage. Requirements for portable tank design shall be in accordance with Chapter 4 of NFPA 30. Shelving, racks, dunnage, scuffboards, floor overlay and similar installations shall be of noncombustible construction or of wood not less than a 25 mm nominal thickness. Adequate material-handling equipment shall be available to handle tanks safely at upper tier levels.
- 32.4.3.7.3 Spill control and secondary containment.** Liquid storage rooms shall be provided with spill control and secondary containment in accordance with Section 25.4.2.
- 32.4.3.7.4 Ventilation.** Liquid storage rooms shall be ventilated in accordance with Section 25.4.3.
- 32.4.3.7.5 Fire protection.** Fire protection for liquid storage rooms shall comply with Sections 32.4.3.7.5.1 and 32.4.3.7.5.2.
- 32.4.3.7.5.1 Fire-extinguishing systems.** Liquid storage rooms shall be protected by automatic sprinkler systems installed in accordance with Chapter 7 and Tables 32.4.3.6.3(4) through 32.4.3.6.3(7) and Table 32.4.3.7.5.1. In-rack sprinklers shall also comply with NFPA 13 and NFPA 231C.

Automatic foam-water systems and automatic aqueous film-forming foam (AFFF) water sprinkler systems shall not be used except when approved. Protection criteria developed from fire modeling or full-scale fire testing conducted at an approved testing laboratory are allowed in lieu of the protection as shown in Tables 32.4.3.6.3(2) through 32.4.3.6.3(7) and Table 32.4.3.7.5.1 when approved.

**TABLE 32.4.3.7.5.1**  
**AUTOMATIC AFFF-WATER PROTECTION REQUIREMENTS FOR SOLID-PILE AND PALLETIZED STORAGE OF LIQUIDS IN METAL CONTAINERS OF 19 LITRESCAPACITY OR LESS<sup>a, b</sup>**

PACKAGE TYPE	CLASS LIQUID	CEILING SPRINKLER DESIGN AND DEMAND					STORAGE HEIGHT (meter )	HOSE DEMAND (L/min) <sup>c</sup>	DURATION AFFF SUPPLY (minimum)	DURATION WATER SUPPLY (hours)
		Density (L/min/m <sup>2</sup> )	Area (square meter)	Temperature rating	Maximum spacing	Orifice size (mm )				
Cartoned	IB, IC, II and III	16.3	186	141°C	9.3 m <sup>2</sup> /head	13.5	3.4	1,893	15	2
Uncartoned	IB, IC, II and III	12.2	186	141°C	9.3 m <sup>2</sup> /head	12.7 or 13.5	3.7	1,893	15	2

- a. System shall be a closed-head wet system with approved devices for proportioning aqueous film-forming foam.  
b. Maximum ceiling height of 9.1 m.  
c. Hose stream demand includes 40 mm inside hand hose, when required.

**32.4.3.7.5.2 Portable fire extinguishers.** A minimum of one approved portable fire extinguisher complying with Section 7.6 and having a rating of not less than 20-B shall be located not less than 3 m or more than 15.2 m from any Class I or II liquid storage area located outside of a liquid storage room.

A minimum of one portable fire extinguisher having a rating of not less than 20-B shall be located outside of, but not more than 3 m from, the door opening into a liquid storage room.

**32.4.3.8 Liquid storage warehouses.** Buildings used for storage of flammable or combustible liquids in quantities exceeding those set forth in Section 32.4.3.4 for control areas and Section 32.4.3.7 for liquid storage rooms shall comply with Sections 32.4.3.8.1 through 32.4.3.8.5 and shall be constructed and separated as required by the SBC.

**32.4.3.8.1 Quantities and storage arrangement.** The total quantities of liquids in a liquid storage warehouse shall not be limited. The arrangement of storage shall be in accordance with Table 32.4.3.6.3(2) or 32.4.3.6.3(3).

**32.4.3.8.1.1 Mixed storage.** Mixed storage shall be in accordance with Section 32.4.3.7.2.1.

**32.4.3.8.1.2 Separation and aisles.** Separation and aisles shall be in accordance with Section 32.4.3.7.2.2.

**32.4.3.8.2 Spill control and secondary containment.** Liquid storage warehouses shall be provided with spill control and secondary containment as set forth in Section 25.4.2.

**32.4.3.8.3 Ventilation.** Liquid storage warehouses storing containers greater than 19 L in capacity shall be ventilated at a rate of not less than 0.0013 m<sup>3</sup>/(s · m<sup>2</sup>) of floor area over the storage area.

**32.4.3.8.4 Fire-extinguishing systems.** Liquid storage warehouses shall be protected by automatic sprinkler systems installed in accordance with Chapter 7 and Tables 32.4.3.6.3(4) through 32.4.3.6.3(7) and Table 32.4.3.7.5.1, or Section 4.8.2 and Tables 4.8.2(a) through (f) of NFPA 30. In-rack sprinklers shall also comply with NFPA 13 and NFPA 231C.

Automatic foam water systems and automatic aqueous film-forming foam water sprinkler systems shall not be used except when approved.

Protection criteria developed from fire modeling or full-scale fire testing conducted at an approved testing laboratory are allowed in lieu of the protection as shown in Tables 32.4.3.6.3(2) through 32.4.3.6.3(7) and Table 32.4.3.7.5.1 when

approved.

**32.4.3.8.5 Warehouse hose lines.** In liquid storage warehouses, either 40 mm lined or 25 mm hard rubber hand hose lines shall be provided in sufficient number to reach all liquid storage areas and shall be in accordance with Section 7.3 or Section 7.5.

**32.4.4 Outdoor storage of containers and portable tanks.** Storage of flammable and combustible liquids in closed containers and portable tanks outside of buildings shall be in accordance with Section 32.3 and Sections 32.4.4.1 through 32.4.4.8. Capacity limits for containers and portable tanks shall be in accordance with Section 32.4.3.

**32.4.4.1 Plans.** Storage shall be in accordance with approved plans.

**32.4.4.2 Location on property.** Outdoor storage of liquids in containers and portable tanks shall be in accordance with Table 32.4.4.2. Storage of liquids near buildings located on the same property shall be in accordance with this section.

**TABLE 32.4.4.2  
OUTDOOR LIQUID STORAGE IN CONTAINERS AND PORTABLE TANKS**

CLASS OF LIQUID	CONTAINER STORAGE— MAXIMUM PER PILE		PORTABLE TANK STORAGE— MAXIMUM PER PILE		MINIMUM DISTANCE BETWEEN PILES OR RACKS (meter)	MINIMUM DISTANCE TO LOT LINE OF PROPERTY THAT CAN BE BUILT UPON <sup>c,d</sup> (meter)	MINIMUM DISTANCE TO PUBLIC STREET, PUBLIC ALLEY OR PUBLIC WAY <sup>d</sup> (meter)
	Quantity <sup>a,b</sup> (litres)	Height (meter)	Quantity <sup>a,b</sup> (litres)	Height (meter)			
IA	4,164	3	8,327	2.1	1.5	15.2	3
IB	8,327	3.7	16,654	4.3	1.5	15.2	3
IC	16,654	3.7	33,308	4.3	1.5	15.2	3
II	33,308	3.7	66,616	4.3	1.5	7.6	1.5
III	83,270	5.5	166,540	4.3	1.5	3	1.5

a. For mixed class storage, see Section 32.4.4.2.

b. For storage in racks, the quantity limits per pile do not apply, but the rack arrangement shall be limited to a maximum of 15.2 m in length and two rows or 2.7 m in depth.

c. If protection by a public Civil Defence or private fire brigade capable of providing cooling water streams is not available, the distance shall be doubled.

d. When the total quantity stored does not exceed 50 percent of the maximum allowed per pile, the distances are allowed to be reduced 50 percent, but not less than 900 mm.

**32.4.4.2.1 Mixed liquid piles.** Where two or more classes of liquids are stored in a single pile, the quantity in the pile shall not exceed the smallest of maximum quantities for the classes of material stored.

**32.4.4.2.2 Access.** Storage of containers or portable tanks shall be provided with fire apparatus access roads in accordance with Chapter 5.

**32.4.4.2.3 Security.** The storage area shall be protected against tampering or trespassers where necessary and shall be kept free from weeds, debris and other combustible materials not necessary to the storage.

**32.4.4.2.4 Storage adjacent to buildings.** A maximum of 4,164 L of liquids stored in closed containers and portable tanks is allowed adjacent to a building located on the same premises and under the same management, provided that:

1. The building does not exceed one story in height. Such building shall be of fire-resistance-rated construction with noncombustible exterior surfaces or noncombustible construction and shall be used principally for the storage of liquids; or
2. The exterior building wall adjacent to the storage area shall have a fire-resistance rating of not less than 2 hours, having no openings to above-grade

areas within 3 m horizontally of such storage and no openings to below-grade areas within 15.2 m horizontally of such storage.

The quantity of liquids stored adjacent to a building protected in accordance with Item 2 is allowed to exceed 4,164 L, provided that the maximum quantity per pile does not exceed 4,164 L and each pile is separated by a 3 m clear space along the common wall.

Where the quantity stored exceeds 4,164 L adjacent to a building complying with Item 1, or the provisions of Item 1 cannot be met, a minimum distance in accordance with the column for distance to a lot line that can be built on in Table 32.4.4.2 shall be maintained between buildings and the nearest container or portable tank.

**32.4.4.3 Spill control and secondary containment.** Storage areas shall be provided with spill control and secondary containment in accordance with Section 32.3.4.

**Exception:** Containers stored on approved containment pallets in accordance with Section 25.4.2.3 and containers stored in cabinets and lockers with integral spill containment.

**32.4.4.4 Security.** Storage areas shall be protected against tampering or trespassers by fencing or other approved control measures.

**32.4.4.5 Protection from vehicles.** Guard posts or other means shall be provided to protect exterior storage tanks from vehicular damage. When guard posts are installed, the posts shall be installed in accordance with Section 5A.12.

**32.4.4.6 Clearance from combustibles.** The storage area shall be kept free from weeds, debris and combustible materials not necessary to the storage. The area surrounding an exterior storage area shall be kept clear of such materials for a minimum distance of 4.6 m.

**32.4.4.7 Weather protection.** Weather protection for outdoor storage shall be in accordance with Section 25.4.13.

**32.4.4.8 Empty containers and tank storage.** The storage of empty tanks and containers previously used for the storage of flammable or combustible liquids, unless free from explosive vapors, shall be stored as required for filled containers and tanks. Tanks and containers when emptied shall have the covers or plugs immediately replaced in openings.

## SECTION 32.5 DISPENSING, USE, MIXING AND HANDLING

**32.5.1 Scope.** Dispensing, use, mixing and handling of flammable liquids shall be in accordance with Section 32.3 and this section. Tank vehicle and tank car loading and unloading and other special operations shall be in accordance with Section 32.6.

**Exception:** Containers of organic coatings having no fire point and which are opened for pigmentation are not required to comply with this section.

**32.5.2 Liquid transfer.** Liquid transfer equipment and methods for transfer of Class I, II and IIIA liquids shall be approved and be in accordance with Sections 32.5.2.1 through 32.5.2.6.

**32.5.2.1 Pumps.** Positive-displacement pumps shall be provided with pressure relief discharging back to the tank, pump suction or other approved location, or shall be provided with interlocks to prevent over-pressure.

**32.5.2.2 Pressured systems.** Where gases are introduced to provide for transfer of Class I liquids, or Class II and III liquids transferred at temperatures at or above their flash

points by pressure, only inert gases shall be used. Controls, including pressure relief devices, shall be provided to limit the pressure so that the maximum working pressure of tanks, containers and piping systems cannot be exceeded. Where devices operating through pressure within a tank or container are used, the tank or container shall be a pressure vessel approved for the intended use. Air or oxygen shall not be used for pressurization.

**Exception:** Air transfer of Class II and Class III liquids at temperatures below their flash points.

**32.5.2.3 Piping, hoses and valves.** Piping, hoses and valves used in liquid transfer operations shall be approved or listed for the intended use.

**32.5.2.4 Class I, II and III liquids.** Class I and II liquids or Class II or Class III liquids that are heated up to or above their flash points shall be transferred by one of the following methods:

**Exception:** Liquids in containers not exceeding a 20 L capacity.

1. From safety cans complying with UL 30.
2. Through an approved closed piping system.
3. From containers or tanks by an approved pump taking suction through an opening in the top of the container or tank.
4. For Class IB, IC, II and III liquids, from containers or tanks by gravity through an approved self-closing or automatic-closing valve when the container or tank and dispensing operations are provided with spill control and secondary containment in accordance with Section 32.3.4. Class IA liquids shall not be dispensed by gravity from tanks.
5. Approved engineered liquid transfer systems.

**32.5.2.5 Manual container filling operations for Class I liquids.** Class I liquids and Class II or III liquids heated to or above their flash points shall not be transferred into containers unless the nozzle and containers are electrically interconnected. Acceptable methods of electrical interconnection include:

1. Metallic floor plates on which containers stand while filling, when such floor plates are electrically connected to the fill stem; or
2. Where the fill stem is bonded to the container during filling by means of a bond wire.

**32.5.2.6 Automatic container-filling operations for Class I liquids.** Container-filling operations for Class I liquids involving conveyor belts or other automatic-feeding operations shall be designed to prevent static accumulations.

**32.5.3 Use, dispensing and mixing inside of buildings.** Indoor use, dispensing and mixing of flammable and combustible liquids shall be in accordance with Sections 32.5.2 and 32.5.3.1 through 32.5.3.5.3.

**32.5.3.1 Closure of mixing or blending vessels.** Vessels used for mixing or blending of Class I liquids and Class II or III liquids heated up to or above their flash points shall be provided with self-closing, tight-fitting, noncombustible lids that will control a fire within such vessel.

**Exception:** Where such devices are impractical, approved automatic or manually controlled fire-extinguishing devices shall be provided.

**32.5.3.2 Bonding of vessels.** Where differences of potential could be created, vessels containing Class I liquids or liquids handled at or above their flash points shall be electrically connected by bond wires, ground cables, piping or similar means to a static grounding system to maintain equipment at the same electrical potential to prevent sparking.

**32.5.3.3 Heating, lighting and cooking appliances.** Heating, lighting and cooking appliances which utilize Class I liquids shall not be operated within a building or structure.

**Exception:** Operation in single-family dwellings.

**32.5.3.4 Location of processing vessels.** Processing vessels shall be located with respect to distances to lot lines of adjoining property which can be built on, in accordance with Tables 32.5.3.4(1) and 32.5.3.4(2).

**Exception:** Where the exterior wall facing the adjoining lot line is a blank wall having a fire-resistance rating of not less than 4 hours, the building code official is authorized to modify the distances. The distance shall not be less than that set forth in the SBC 201, and when Class IA or unstable liquids are involved; explosion control shall be provided in accordance with Section 7.11.

**TABLE 32.5.3.4(1)  
SEPARATION OF PROCESSING VESSELS FROM LOT LINES**

PROCESSING VESSELS WITH EMERGENCY RELIEF VENTING	LOCATION <sup>a</sup>	
	Stable liquids	Unstable liquids
Not in excess of 17.2 kPa	Table 32.5.3.4(2)	2.5 times Table 32.5.3.4(2)
Over 17.2 kPa	1.5 times Table 32.5.3.4(2)	4 times Table 32.5.3.4(2)

a. Where protection of exposures by a public Civil Defence or private fire brigade capable of providing cooling water streams on structures is not provided, distances shall be doubled.

**TABLE 32.5.3.4(2)  
REFERENCE TABLE FOR USE WITH TABLE 32.5.3.4(1)**

TANK CAPACITY (litres )	MINIMUM DISTANCE FROM LOT LINE OF A LOT WHICH IS OR CAN BE BUILT UPON, INCLUDING THE OPPOSITE SIDE OF A PUBLIC WAY (meter )	MINIMUM DISTANCE FROM NEAREST SIDE OF ANY PUBLIC WAY OR FROM NEAREST IMPORTANT BUILDING ON THE SAME PROPERTY (meter)
1,041 or less	1.5	1.5
1,045 to 2,839	3	1.5
2,843 to 45,420	4.6	1.5
45,424 to 113,550	6.1	1.5
113,554 to 189,250	9.1	3
189,254 to 378,500	15.2	4.6
378,504 to 1,892,500	24.4	7.6
1,892,504 to 3,785,000	30.5	10.7
3,785,004 to 7,570,000	41.1	13.7
7,570,004 to 11,355,000	50.3	16.8
11,355,004 or more	53.3	18.3

**32.5.3.5 Quantity limits for use.** Liquid use quantity limitations shall comply with Sections 32.5.3.5.1 through 32.5.3.5.3.

**32.5.3.5.1 Maximum allowable quantity per control area.** Indoor use, dispensing and mixing of flammable and combustible liquids shall not exceed the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) and shall not exceed the additional limitations set forth in Section 32.5.3.5.

**Exception:** Cleaning with Class I, II and IIIA liquids shall be in accordance with Section 32.5.3.6.

Use of hazardous production material flammable and combustible liquids in Group H-5 occupancies shall be in accordance with Chapter 16.

**32.5.3.5.2 Occupancy quantity limits.** The following limits for quantities of flammable and combustible liquids used, dispensed or mixed based on occupancy classification shall not be exceeded.

**Exception:** Cleaning with Class I, II, or IIIA liquids shall be in accordance with Section 32.5.3.6.

1. Group A occupancies: Quantities in Group A occupancies shall not exceed that necessary for demonstration, treatment, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
2. Group B occupancies: Quantities in drinking, dining, office and school uses within Group B occupancies shall not exceed that necessary for demonstration, treatment, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
3. Group E occupancies: Quantities in Group E occupancies shall not exceed that necessary for demonstration, treatment, laboratory work, maintenance purposes and operation of equipment and shall not exceed quantities set forth in Table 25.3.1.1(1).
4. Group F occupancies: Quantities in dining, office and school uses within Group F occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
5. Group I occupancies: Quantities in Group I occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
6. Group M occupancies: Quantities in dining, office and school uses within Group M occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
7. Group R occupancies: Quantities in Group R occupancies shall not exceed that necessary for maintenance purposes and operation of equipment, and shall not exceed quantities set forth in Table 25.3.1.1(1).
8. Group S occupancies: Quantities in dining and office uses within Group S occupancies shall not exceed that necessary for demonstration, laboratory work, maintenance purposes and operation of equipment and shall not exceed quantities set forth in Table 25.3.1.1 (1).

**32.5.3.5.3 Quantities exceeding limits for control areas.** Quantities exceeding the maximum allowable quantity per control area indicated in Sections 32.5.3.5.1 and 32.5.3.5.2 shall be in accordance with the following:

1. For open systems, indoor use, dispensing and mixing of flammable and combustible liquids shall be within a room or building complying with the SBC 201 and Sections 32.5.3.7.1 through 32.5.3.7.5.
2. For closed systems, indoor use, dispensing and mixing of flammable and combustible liquids shall be within a room or building complying with the SBC 201 and Sections 32.5.3.7 through 32.5.3.7.4 and 32.5.3.7.6.

**32.5.3.6 Cleaning with flammable and combustible liquids.** Cleaning with Class I, II and IIIA liquids shall be in accordance with this section.

**Exceptions:**

1. Dry cleaning shall be in accordance with Chapter 13.



2. Spray-nozzle cleaning shall be in accordance with Section 12.3.5.

**32.5.3.6.1 Cleaning operations.** Class I-A liquids shall not be used for cleaning. Cleaning with Class I-B, I-C or II liquids shall be conducted as follows:

1. In a room or building in accordance with Section 32.5.3.7; or
2. In a machine listed and approved for the purpose in accordance with Section 32.5.3.6.2.

**Exception:** Materials used in commercial and industrial process-related cleaning operations in accordance with other provisions of these code requirements and not involving facilities maintenance cleaning operations.

**32.5.3.6.2 Listed and approved machines.** Parts cleaning and degreasing conducted in listed and approved machines in accordance with Section 32.5.3.6.1 shall be in accordance with Sections 32.5.3.6.2.1 through 32.5.3.6.2.7.

**32.5.3.6.2.1 Solvents.** Solvents shall be classified and shall be compatible with the machines within which they are used.

**32.5.3.6.2.2 Machine capacities.** The quantity of solvent shall not exceed the listed design capacity of the machine for the solvent being used with the machine.

**32.5.3.6.2.3 Solvent quantity limits.** Solvent quantities shall be limited as follows:

1. Machines without remote solvent reservoirs shall be limited to quantities set forth in Section 32.5.3.5.
2. Machines with remote solvent reservoirs using Class I liquids shall be limited to quantities set forth in Section 32.5.3.5.
3. Machines with remote solvent reservoirs using Class II liquids shall be limited to 132 L per machine. The total quantities shall not exceed an aggregate of 908 L per control area in buildings not equipped throughout with an approved automatic sprinkler system and an aggregate of 1,817 L per control area in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1.
4. Machines with remote solvent reservoirs using Class IIIA liquids shall be limited to 303 L per machine.

**32.5.3.6.2.4 Immersion soaking of parts.** Work areas of machines with remote solvent reservoirs shall not be used for immersion soaking of parts.

**32.5.3.6.2.5 Separation.** Multiple machines shall be separated from each other by a distance of not less than 900 mm or by a fire barrier with a minimum 1 hour fire-resistance rating.

**32.5.3.6.2.6 Ventilation.** Machines shall be located in areas adequately ventilated to prevent accumulation of vapors.

**32.5.3.6.2.7 Installation.** Machines shall be installed in accordance with their listings.

**32.5.3.7 Rooms or buildings for quantities exceeding the maximum allowable quantity per control area.** Where required by Section 32.5.3.5.3 or 32.5.3.6.1, rooms or buildings used for use, dispensing or mixing of flammable and combustible liquids shall be in accordance with Sections 32.5.3.7.1 through 32.5.3.7.6.3.

**32.5.3.7.1 Construction, location and fire protection.** Rooms or buildings classified in accordance with the SBC 201 as Group H-2 or H-3 occupancies based on use, dispensing or mixing of flammable or combustible liquids shall be constructed in accordance with the SBC.

**32.5.3.7.2 Basements.** In rooms or buildings classified in accordance with the SBC 201 as Group H-2 or H-3, dispensing or mixing of flammable or combustible liquids shall not be conducted in basements.

**32.5.3.7.3 Fire protection.** Rooms or buildings classified in accordance with the SBC 201 as Group H-2 or H-3 occupancies shall be equipped with an approved automatic fire-

extinguishing system in accordance with Chapter 9.

**32.5.3.7.4 Doors.** Interior doors to rooms or portions of such buildings shall be self-closing fire doors in accordance with the SBC 201.

**32.5.3.7.5 Open systems.** Use, dispensing and mixing of flammable and combustible liquids in open systems shall be in accordance with Sections 32.5.3.7.5.1 through 32.5.3.7.5.3.

**32.5.3.7.5.1 Ventilation.** Continuous mechanical ventilation shall be provided at a rate of not less than  $0.0051 \text{ m}^2/(\text{s} \cdot \text{m}^2)$  of floor area over the design area. Provisions shall be made for introduction of makeup air in such a manner to include all floor areas or pits where vapors can collect. Local or spot ventilation shall be provided when needed to prevent the accumulation of hazardous vapors. Ventilation system design shall comply with the SBC 201 and SBC 501.

**Exception:** Where natural ventilation can be shown to be effective for the materials used, dispensed or mixed.

**32.5.3.7.5.2 Explosion control.** Explosion control shall be provided in accordance with Section 7.11.

**32.5.3.7.5.3 Spill control and secondary containment.** Spill control shall be provided in accordance with Section 32.3.4 where Class I, II or IIIA liquids are dispensed into containers exceeding a 5 L capacity or mixed or used in open containers or systems exceeding 20 L capacity. Spill control and secondary containment shall be provided in accordance with Section 32.3.4 when the capacity of an individual container exceeds 208 L or the aggregate capacity of multiple containers or tanks exceeds 379 L.

**32.5.3.7.6 Closed systems.** Use or mixing of flammable or combustible liquids in closed systems shall be in accordance with Sections 32.5.3.7.6.1 through 32.5.3.7.6.3.

**32.5.3.7.6.1 Ventilation.** Closed systems designed to be opened as part of normal operations shall be provided with ventilation in accordance with Section 32.5.3.7.5.1.

**32.5.3.7.6.2 Explosion control.** Explosion control shall be provided when an explosive environment can occur as a result of the mixing or use process. Explosion control shall be designed in accordance with Section 7.11.

**Exception:** When process vessels are designed to contain fully the worst-case explosion anticipated within the vessel under process conditions considering the most likely failure.

**32.5.3.7.6.3 Spill control and secondary containment.** Spill control shall be provided in accordance with Section 32.3.4 when flammable or combustible liquids are dispensed into containers exceeding a 5 L capacity or mixed or used in open containers or systems exceeding a 20 L capacity. Spill control and secondary containment shall be provided in accordance with Section 32.3.4 when the capacity of an individual container exceeds 208 L or the aggregate capacity of multiple containers or tanks exceeds 3,785 L.

**32.5.3.8 Use, dispensing and handling outside of buildings.** Outside use, dispensing and handling shall be in accordance with Sections 32.5.3.8.1 through 32.5.3.8.3. Dispensing of liquids into motor vehicle fuel tanks at motor fuel-dispensing facilities shall be in accordance with Chapter 20.

**32.5.3.8.1 Spill control and drainage control.** Outside use, dispensing and handling areas shall be provided with spill control as set forth in Section 32.3.4.

**32.5.3.8.2 Location on property.** Dispensing activities which exceed the quantities set forth in Table 32.5.3.8.2 shall not be conducted within 4.6 m of buildings or combustible materials or within 7.6 m of building openings, lot lines, public streets, public alleys or public ways. Dispensing activities that exceed the quantities set forth in Table 32.5.3.8.2 shall not be conducted within 4.6 m of

storage of Class I, II or III liquids unless such liquids are stored in tanks which are listed and labeled as 2 hour protected tank assemblies in accordance with UL 2085.

**Exceptions:**

1. The requirements shall not apply to areas where only the following are dispensed: Class III liquids; liquids that are heavier than water; water-miscible liquids; and liquids with viscosities greater than 10,000 centipoise (cp).
2. Flammable and combustible liquid dispensing in refineries, chemical plants, process facilities, gas and crude oil production facilities and oil blending and packaging facilities, terminals and bulk plants.

**32.5.3.8.3 Location of processing vessels.** Processing vessels shall be located with respect to distances to lot lines which can be built on in accordance with Table 32.5.3.4(1).

**Exception:** In refineries and distilleries.

**32.5.4 Solvent distillation units.** Solvent distillation units shall comply with Sections 32.5.4.1 through 32.5.4.9.

**32.5.4.1 Unit with a capacity of 227 litres or less.** Solvent distillation units used to recycle Class I, II or IIIA liquids having a distillation chamber capacity of 227 L or less shall be listed, labeled and installed in accordance with Section 32.5.4 and UL 2208.

**Exceptions:**

1. Solvent distillation units installed in dry cleaning plants in accordance with Chapter 13.
2. Solvent distillation units used in continuous through-put industrial processes where the source of heat is remotely supplied using steam, hot water, oil or other heat transfer fluids, the temperature of which is below the auto-ignition point of the solvent.
3. Solvent distillation units listed for and used in laboratories.
4. Approved research, testing and experimental processes.

**TABLE 32.5.3.8.2  
MAXIMUM ALLOWABLE QUANTITIES FOR DISPENSING OF FLAMMABLE AND  
COMBUSTIBLE LIQUIDS IN OUTDOOR CONTROL AREAS<sup>a,b</sup>**

CLASS OF LIQUID	QUANTITY (litres)
<b>Flammable</b>	
Class IA	38
Class IB	57
Class IC	76
Combination Class IA, IB and IC	114 <sup>c</sup>
<b>Combustible</b>	
Class II	114
Class IIIA	303
Class IIIB	12,491

a. For definition of "Outdoor Control Area," see Section 25.2.1.

b. The building code official is authorized to impose special conditions regarding locations, types of containers, dispensing units, fire control measures and other factors involving fire safety.

c. Containing not more than the maximum allowable quantity per control area of each individual class.

- 32.5.4.2 Units with a capacity exceeding 227 litres.** Solvent distillation units used to recycle Class I, II or IIIA liquids, having a distillation chamber capacity exceeding 227 L shall be used in locations that comply with the use and mixing requirements of Section 32.5 and other applicable provisions in this chapter.
- 32.5.4.3 Prohibited processing.** Class I, II and IIIA liquids also classified as unstable (reactive) shall not be processed in solvent distillation units.  
**Exception:** Appliances listed for the distillation of unstable (reactive) solvents.
- 32.5.4.4 Labeling.** A permanent label shall be affixed to the unit by the manufacturer. The label shall indicate the capacity of the distillation chamber, and the distance the unit shall be placed away from sources of ignition. The label shall indicate the products for which the unit has been listed for use or refer to the instruction manual for a list of the products.
- 32.5.4.5 Manufacturer's instruction manual.** An instruction manual shall be provided. The manual shall be readily available for the user and the building code official. The manual shall include installation, use and servicing instructions. It shall identify the liquids for which the unit has been listed for distillation purposes along with each liquid's flash point and auto-ignition temperature. For units with adjustable controls, the manual shall include directions for setting the heater temperature for each liquid to be instilled.
- 32.5.4.6 Location.** Solvent distillation units shall be used in locations in accordance with the listing. Solvent distillation units shall not be used in basements.
- 32.5.4.7 Storage of liquids.** Distilled liquids and liquids awaiting distillation shall be stored in accordance with Section 32.4.
- 32.5.4.8 Storage of residues.** Hazardous residue from the distillation process shall be stored in accordance with Section 32.4 and Chapter 25.
- 32.5.4.9 Portable fire extinguishers.** Approved portable fire extinguishers shall be provided in accordance with Section 7.6. At least one portable fire extinguisher having a rating of not less than 40-B shall be located not less than 3 m or more than 9.1 m from any solvent distillation unit.

## SECTION 32.6 SPECIAL OPERATIONS

- 32.6.1 General.** This section shall cover the provisions for special operations which include, but are not limited to, storage, use, dispensing, mixing or handling of flammable and combustible liquids. The following special operations shall be in accordance with Sections 32.1, 32.3, 32.4 and 32.5, except as provided in Section 32.6.
1. Storage and dispensing of flammable and combustible liquids on farms and construction sites.
  2. Well drilling and operating.
  3. Bulk plants or terminals.
  4. Bulk transfer and process transfer operations utilizing tank vehicles and tank cars.
  5. Tank vehicles and tank vehicle operation.
  6. Refineries.
  7. Vapor recovery and vapor-processing systems.
- 32.6.2 Storage and dispensing of flammable and combustible liquids on farms and construction sites.** Permanent and temporary storage and dispensing of Class I and II liquids for private use on farms and rural areas and at construction sites,

earth-moving projects, gravel pits or borrow pits shall be in accordance with Sections 32.6.2.1 through 32.6.2.8.1.

**Exception:** Storage and use of fuel oil and containers connected with oil-burning equipment regulated by Section 5D.3 and the SBC 501.

**32.6.2.1 Combustibles and open flames near tanks.** Storage areas shall be kept free from weeds and extraneous combustible material. Open flames and smoking are prohibited in flammable or combustible liquid storage areas.

**32.6.2.2 Marking of tanks and containers.** Tanks and containers for the storage of liquids above ground shall be conspicuously marked with the name of the product which they contain and the words: FLAMMABLE — KEEP FIRE AND FLAME AWAY. Tanks shall bear the additional marking: KEEP 15.2 METER FROM BUILDINGS.

**32.6.2.3 Containers for storage and use.** Metal containers used for storage of Class I or II liquids shall be in accordance with MOI requirements or shall be of an approved design. Discharge devices shall be of a type that do not develop an internal pressure on the container. Pumping devices or approved self-closing faucets used for dispensing liquids shall not leak and shall be well-maintained. Individual containers shall not be interconnected and shall be kept closed when not in use. Containers stored outside of buildings shall be in accordance with Section 32.4 and the SBC 201.

**32.6.2.4 Permanent and temporary tanks.** The capacity of permanent above-ground tanks containing Class I or II liquids shall not exceed 4,164 L. The capacity of temporary above-ground tanks containing Class I or II liquids shall not exceed 37,850 L. Tanks shall be of the single-compartment design.

**Exception:** Permanent above-ground tanks of greater capacity which meet the requirements of Section 32.4.2.

**32.6.2.4.1 Fill-opening security.** Fill openings shall be equipped with a locking closure device. Fill openings shall be separate from vent openings.

**32.6.2.4.2 Vents.** Tanks shall be provided with a method of normal and emergency venting. Normal vents shall also be in accordance with Section 32.4.2.7.3. Emergency vents shall be in accordance with Section 32.4.2.7.4. Emergency vents shall be arranged to discharge in a manner which prevents localized overheating or flame impingement on any part of the tank in the event that vapors from such vents are ignited.

**32.6.2.4.3 Location.** Tanks containing Class I or II liquids shall be kept outside and at least 15.2 m from buildings and combustible storage. Additional distance shall be provided when necessary to ensure that vehicles, equipment and containers being filled directly from such tanks will not be less than 15.2 m from structures, haystacks or other combustible storage.

**32.6.2.4.4 Locations where above-ground tanks are prohibited.** The storage of Class I and II liquids in above-ground tanks is prohibited within the limits established by law in the adopting ordinance as the limits of districts in which such storage is prohibited.

**32.6.2.5 Type of tank.** Tanks shall be provided with top openings only or shall be elevated for gravity discharge.

**32.6.2.5.1 Tanks with top openings only.** Tanks with top openings shall be mounted as follows:

1. On well-constructed metal legs connected to shoes or runners designed so that the tank is stabilized and the entire tank and its supports can be moved as a unit; or

2. For stationary tanks, on a stable base of timbers or blocks approximately 150 mm in height which prevents the tank from contacting the ground.

**32.6.2.5.1.1 Pumps and fittings.** Tanks with top openings only shall be equipped with a tightly and permanently attached, approved pumping device having an approved hose of sufficient length for filling vehicles, equipment or containers to be served from the tank. Either the pump or the hose shall be equipped with a padlock to its hanger to prevent tampering. An effective antisiphoning device shall be included in the pump discharge unless a self-closing nozzle is provided. Siphons or internal pressure discharge devices shall not be used.

**32.6.2.5.2 Tanks for gravity discharge.** Tanks with a connection in the bottom or the end for gravity-dispensing liquids shall be mounted and equipped as follows:

1. Supports to elevate the tank for gravity discharge shall be designed to carry all required loads and provide stability.
2. Bottom or end openings for gravity discharge shall be equipped with a valve located adjacent to the tank shell which will close automatically in the event of fire through the operation of an effective heat-activated releasing device. Where this valve cannot be operated manually, it shall be supplemented by a second, manually operated valve.

The gravity discharge outlet shall be provided with an approved hose equipped with a self-closing valve at the discharge end of a type that can be padlocked to its hanger.

**32.6.2.6 Spill control drainage control and diking.** Indoor storage and dispensing areas shall be provided with spill control and drainage control as set forth in Section 32.3.4. Outdoor storage areas shall be provided with drainage control or diking as set forth in Section 32.4.2.10.

**32.6.2.7 Portable fire extinguishers.** Portable fire extinguishers with a minimum rating of 20-B:C and complying with Section 7.6 shall be provided where required by the building code official.

**32.6.2.8 Dispensing from tank vehicles.** Where approved, liquids used as fuels are allowed to be transferred from tank vehicles into the tanks of motor vehicles or special equipment, provided:

1. The tank vehicle's specific function is that of supplying fuel to motor vehicle fuel tanks.
2. The dispensing line does not exceed 30.5 m in length.
3. The dispensing nozzle is an approved type.
4. The dispensing hose is properly placed on the approved reel or in a compartment provided before the tank vehicle is moved.
5. Signs prohibiting smoking or open flames within 7.6 m of the vehicle or the point of refueling are prominently posted on the tank vehicle.
6. Electrical devices and wiring in areas where fuel dispensing is conducted are in accordance with the SBC 401.
7. Tank vehicle-dispensing equipment is operated only by designated personnel who are trained to handle and dispense motor fuels.
8. Provisions are made for controlling and mitigating unauthorized discharges.

**32.6.2.8.1 Location.** Dispensing from tank vehicles shall be conducted at least 15.2 m from structures or combustible storage.

**32.6.3 Well drilling and operating.** Wells for oil and natural gas shall be drilled and operated in accordance with Sections 32.6.3.1 through 32.6.3.8.

**32.6.3.1 Location.** The location of wells shall comply with Sections 32.6.3.1.1 through 32.6.3.1.3.2.

- 32.6.3.1.1 Storage tanks and sources of ignition.** Storage tanks or boilers, fired heaters, open-flame devices or other sources of ignition shall not be located within 7.6 m of well heads. Smoking is prohibited at wells or tank locations except as designated and in approved posted areas.  
**Exception:** Engines used in the drilling, production and serving of wells.
- 32.6.3.1.2 Streets and railways.** Wells shall not be drilled within 22.9 m of any dedicated public street, highway or nearest rail of an operating railway.
- 32.6.3.1.3 Buildings.** Wells shall not be drilled within 30.5 m of buildings not necessary to the operation of the well.
- 32.6.3.1.3.1 Group A, E or I buildings.** Wells shall not be drilled within 91.4 m of buildings with an occupancy in Group A, E or I.
- 32.6.3.1.3.2 Existing wells.** Where wells are existing, buildings shall not be constructed within the distances set forth in Section 32.6.3.1 for separation of wells or buildings.
- 32.6.3.2 Waste control.** Control of waste materials associated with wells shall comply with Sections 32.6.3.2.1 and 32.6.3.2.2.
- 32.6.3.2.1 Discharge on a street or water channel.** Liquids containing crude petroleum or its products shall not be discharged into or on streets, highways, drainage canals or ditches, storm drains or flood control channels.
- 32.6.3.2.2 Discharge and combustible materials on ground.** The surface of the ground under, around or near wells, pumps, boilers, oil storage tanks or buildings shall be kept free from oil, waste oil, refuse or waste material.
- 32.6.3.3 Sumps.** Sumps associated with wells shall comply with Sections 32.6.3.3.1 through 32.6.3.3.3.
- 32.6.3.3.1 Maximum width.** Sumps or other basins for the retention of oil or petroleum products shall not exceed 3.7 m in width.
- 32.6.3.3.2 Backfilling.** Sumps or other basins for the retention of oil or petroleum products larger than 1.8 m by 1.8 m by 1.8 m shall not be maintained longer than 60 days after the cessation of drilling operations.
- 32.6.3.3.3 Security.** Sumps, diversion ditches and depressions used as sumps shall be securely fenced or covered.
- 32.6.3.4 Prevention of blowouts.** Protection shall be provided to control and prevent the blowout of a well. Protection equipment shall meet applicable jurisdiction requirements.
- 32.6.3.5 Storage tanks.** Storage of flammable or combustible liquids in tanks shall be in accordance with Section 32.4. Oil storage tanks or groups of tanks shall have posted in a conspicuous place, on or near such tank or tanks, an approved sign with the name of the owner or operator, or the lease number and the telephone number where a responsible person can be reached at any time.
- 32.6.3.6 Soundproofing.** Where soundproofing material is required during oil field operations, such material shall be noncombustible.
- 32.6.3.7 Signs.** Well locations shall have posted in a conspicuous place on or near such tank or tanks an approved sign with the name of the owner or operator, name of the leasee or the lease number, the well number and the telephone number where a responsible person can be reached at any time. Such signs shall be maintained on the premises from the time materials are delivered for drilling purposes until the well is abandoned.
- 32.6.3.8 Field-loading racks.** Field-loading racks shall be in accordance with Section 32.6.5.
- 32.6.4 Bulk plants or terminals.** Portions of properties where flammable and combustible liquids are received by tank vessels, pipelines, tank cars or tank

vehicles and which are stored or blended in bulk for the purpose of distributing such liquids by tank vessels, pipelines, tanks cars, tank vehicles or containers shall be in accordance with Sections 32.6.4.1 through 32.6.4.10.4.

- 32.6.4.1 Building construction.** Buildings shall be constructed in accordance with the SBC.
- 32.6.4.2 Means of egress.** Rooms in which liquids are stored, used or transferred by pumps shall have means of egress arranged to prevent occupants from being trapped in the event of fire.
- 32.6.4.3 Heating.** Rooms in which Class I liquids are stored or used shall be heated only by means not constituting a source of ignition, such as steam or hot water. Rooms containing heating appliances involving sources of ignition shall be located and arranged to prevent entry of flammable vapors.
- 32.6.4.4 Ventilation.** Ventilation shall be provided for rooms, buildings and enclosures in which Class I liquids are pumped, used or transferred. Design of ventilation systems shall consider the relatively high specific gravity of the vapors. When natural ventilation is used, adequate openings in outside walls at floor level, unobstructed except by louvers or coarse screens, shall be provided. When natural ventilation is inadequate, mechanical ventilation shall be provided in accordance with the SBC 501.
  - 32.6.4.4.1 Basements and pits.** Class I liquids shall not be stored or used within a building having a basement or pit into which flammable vapors can travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.
  - 32.6.4.4.2 Dispensing of Class I liquids.** Containers of Class I liquids shall not be drawn from or filled within buildings unless a provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable vapors could be present.
- 32.6.4.5 Storage.** Storage of Class I, II and IIIA liquids in bulk plants shall be in accordance with the applicable provisions of Section 32.4.
- 32.6.4.6 Overfill protection of Class I liquids.** Manual and automatic systems shall be provided to prevent overfill during the transfer of Class I liquids from mainline pipelines and marine vessels in accordance with API 2350.
- 32.6.4.7 Wharves.** This section shall apply to all wharves, piers, bulkheads and other structures over or contiguous to navigable water having a primary function of transferring liquid cargo in bulk between shore installations and tank vessels, ships, barges, lighter boats or other mobile floating craft.
  - Exception:** Marine motor fuel-dispensing facilities in accordance with Chapter 20.
- 32.6.4.7.1 Transferring approvals.** Handling packaged cargo of liquids, including full and empty drums, bulk fuel and stores, over a wharf during cargo transfer shall be subject to the approval of the wharf supervisor and the senior deck officer on duty.
- 32.6.4.7.2 Transferring location.** Wharves at which liquid cargoes are to be transferred in bulk quantities to or from tank vessels shall be at least 30.5 m from any bridge over a navigable waterway; or from an entrance to, or superstructure of, any vehicular or railroad tunnel under a waterway. The termination of the fixed piping used for loading or unloading at a wharf shall be at least 61 m from a bridge or from an entrance to, or superstructures of, a tunnel.
- 32.6.4.7.3 Superstructure and decking material.** Superstructure and decking shall be designed for the intended use. Decking shall be constructed of materials that will afford the desired combination of flexibility, resistance to shock, durability, strength and fire resistance.



- 32.6.4.7.4 Tanks allowed.** Tanks used exclusively for ballast water or Class II or III liquids are allowed to be installed on suitably designed wharves.
- 32.6.4.7.5 Transferring equipment.** Loading pumps capable of building up pressures in excess of the safe working pressure of cargo hose or loading arms shall be provided with bypasses, relief valves or other arrangements to protect the loading facilities against excessive pressure. Relief devices shall be tested at least annually to determine that they function satisfactorily at their set pressure.
- 32.6.4.7.6 Piping, valves and fittings.** Piping valves and fittings shall be in accordance with Section 32.3.6 except as modified by the following:
1. Flexibility of piping shall be ensured by appropriate layout and arrangement of piping supports so that motion of the wharf structure resulting from wave action, currents, tides or the mooring of vessels will not subject the pipe to repeated excessive strain.
  2. Pipe joints that depend on the friction characteristics of combustible materials or on the grooving of pipe ends for mechanical continuity of piping shall not be used.
  3. Swivel joints are allowed in piping to which hoses are connected and for articulated, swivel-joint transfer systems, provided the design is such that the mechanical strength of the joint will not be impaired if the packing materials fail such as by exposure to fire.
  4. Each line conveying Class I or II liquids leading to a wharf shall be provided with a readily accessible block valve located on shore near the approach to the wharf and outside of any diked area. Where more than one line is involved, the valves shall be grouped in one location.
  5. Means shall be provided for easy access to cargo line valves located below the wharf deck.
  6. Piping systems shall contain a sufficient number of valves to operate the system properly and to control the flow of liquid in normal operation and in the event of physical damage.
  7. Piping on wharves shall be bonded and grounded where Class I and II liquids are transported. Where excessive stray currents are encountered, insulating joints shall be installed. Bonding and grounding connections on piping shall be located on the wharf side of hose riser insulating flanges, where used, and shall be accessible for inspection.
  8. Hose or articulated swivel-joint pipe connections used for cargo transfer shall be capable of accommodating the combined effects of change in draft and maximum tidal range, and mooring lines shall be kept adjusted to prevent surge of the vessel from placing stress on the cargo transfer system.
  9. Hoses shall be supported to avoid kinking and damage from chafing.
- 32.6.4.7.7 Loading and unloading.** Loading or discharging shall not commence until the wharf superintendent and officer in charge of the tank vessel agree that the tank vessel is properly moored and connections are properly made.
- 32.6.4.7.8 Mechanical work.** Mechanical work shall not be performed on the wharf during cargo transfer, except under special authorization by the building code official based on a review of the area involved, methods to be employed and precautions necessary.
- 32.6.4.8 Sources of ignition.** Class I, II or IIIA liquids shall not be used, drawn or dispensed where flammable vapors can reach a source of ignition. Smoking shall be prohibited except in designated locations. "No Smoking" signs complying with Section 5A.10 shall be conspicuously posted where a hazard from flammable vapors is normally present.

- 32.6.4.9 Drainage control.** Loading and unloading areas shall be provided with drainage control in accordance with Section 32.4.2.10.
- 32.6.4.10 Fire protection.** Fire protection shall be in accordance with Chapter 7 and Sections 32.6.4.10.1 through 32.6.4.10.4.
- 32.6.4.10.1 Portable fire extinguishers.** Portable fire extinguishers with a rating of not less than 20-B and complying with Section 7.6 shall be located within 22.9 m of hose connections, pumps and separator tanks.
- 32.6.4.10.2 Fire hoses.** Where piped water is available, ready-connected fire hose in a size appropriate for the water supply shall be provided in accordance with Section 7.5 so that manifolds where connections are made and broken can be reached by at least one hose stream.
- 32.6.4.10.3 Obstruction of equipment.** Material shall not be placed on wharves in such a manner that would obstruct access to fire-fighting equipment or important pipeline control valves.
- 32.6.4.10.4 Fire apparatus access.** Where the wharf is accessible to vehicular traffic, an unobstructed fire apparatus access road to the shore end of the wharf shall be maintained in accordance with Chapter 5.
- 32.6.5 Bulk transfer and process transfer operations.** Bulk transfer and process transfer operations shall be approved and be in accordance with Sections 32.6.5.1 through 32.6.5.4.4. Motor fuel-dispensing facilities shall comply with Chapter 20.
- 32.6.5.1 General.** The provisions of Sections 32.6.5.1.1 through 32.6.5.1.18 shall apply to bulk transfer and process transfer operations; Sections 32.6.5.2 and 32.6.5.2.1 shall apply to bulk transfer operations; Sections 32.6.5.3 through 32.6.5.3.3 shall apply to process transfer operations and Sections 32.6.5.4 through 32.6.5.4.4 shall apply to dispensing from tank vehicles and tank cars.
- 32.6.5.1.1 Location.** Bulk transfer and process transfer operations shall be conducted in approved locations. Tank cars shall be unloaded only on private sidings or railroad-siding facilities equipped for transferring flammable or combustible liquids. Tank vehicle and tank car transfer facilities shall be separated from buildings, above-ground tanks, combustible materials, lot lines, public streets, public alleys or public ways by a distance of 7.6 m for Class I liquids and 4.6 for Class II and III liquids measured from the nearest position of any loading or unloading valve. Buildings for pumps or shelters for personnel shall be considered part of the transfer facility.
- 32.6.5.1.2 Weather protection canopies.** Where weather protection canopies are provided, they shall be constructed in accordance with Section 25.4.13. Weather protection canopies shall not be located within 4.6 m of a building or combustible material or within 7.6 m of building openings, lot lines, public streets, public alleys or public ways.
- 32.6.5.1.3 Ventilation.** Ventilation shall be provided to prevent accumulation of vapors in accordance with Section 32.5.3.7.5.1.
- 32.6.5.1.4 Sources of ignition.** Sources of ignition shall be controlled or eliminated in accordance with Section 25.3.7.
- 32.6.5.1.5 Spill control and secondary containment.** Areas where transfer operations are located shall be provided with spill control and secondary containment in accordance with Section 32.3.4. The spill control and secondary containment system shall have a design capacity capable of containing the capacity of the largest tank compartment located in the area where transfer operations are conducted. Containment of the rainfall volume specified in Section 25.4.2.2.6 is not required.

**32.6.5.1.6 Fire protection.** Fire protection shall be in accordance with Section 32.3.2.

**32.6.5.1.7 Static protection.** Static protection shall be provided to prevent the accumulation of static charges during transfer operations. Bonding facilities shall be provided during the transfer through open domes where Class I liquids are transferred, or where Class II and III liquids are transferred into tank vehicles or tank cars which could contain vapors from previous cargoes of Class I liquids.

Protection shall consist of a metallic bond wire permanently electrically connected to the fill stem. The fill pipe assembly shall form a continuous electrically conductive path downstream from the point of bonding. The free end of such bond wire shall be provided with a clamp or equivalent device for convenient attachment to a metallic part in electrical contact with the cargo tank of the tank vehicle or tank car. For tank vehicles, protection shall consist of a flexible bond wire of adequate strength for the intended service and the electrical resistance shall not exceed 1 megohm. For tank cars, bonding shall be provided where the resistance of a tank car to ground through the rails is 25 ohms or greater.

Such bonding connection shall be fastened to the vehicle, car or tank before dome covers are raised and shall remain in place until filling is complete and all dome covers have been closed and secured.

**Exceptions:**

1. Where vehicles and cars are loaded exclusively with products not having a static-accumulating tendency, such as asphalt, cutback asphalt, most crude oils, residual oils and water-miscible liquids.
2. When Class I liquids are not handled at the transfer facility and the tank vehicles are used exclusively for Class II and III liquids.
3. Where vehicles and cars are loaded or unloaded through closed top or bottom connections whether the hose is conductive or nonconductive.

Filling through open domes into the tanks of tank vehicles or tank cars that contain vapor-air mixtures within the flammable range, or where the liquid being filled can form such a mixture, shall be by means of a downspout which extends to near the bottom of the tank.

**32.6.5.1.8 Stray current protection.** Tank car loading facilities where Class I, II or IIIA liquids are transferred through open domes shall be protected against stray currents by permanently bonding the pipe to at least one rail and to the transfer apparatus. Multiple pipes entering the transfer areas shall be permanently electrically bonded together. In areas where excessive stray currents are known to exist, all pipes entering the transfer area shall be provided with insulating sections to isolate electrically the transfer apparatus from the pipelines.

**32.6.5.1.9 Top loading.** When top loading a tank vehicle with Class I and II liquids without vapor control, valves used for the final control of flow shall be of the self-closing type and shall be manually held open except where automatic means are provided for shutting off the flow when the tank is full. When used, automatic shutoff systems shall be provided with a manual shutoff valve located at a safe distance from the loading nozzle to stop the flow if the automatic system fails.

When top loading a tank vehicle with vapor control, flow control shall be in accordance with Section 32.6.5.1.10. Self-closing valves shall not be tied or locked in the open position.

**32.6.5.1.10 Bottom loading.** When bottom loading a tank vehicle or tank car with or without vapor control, a positive means shall be provided for loading a predetermined quantity of liquid, together with an automatic secondary shutoff control to prevent overfill. The connecting components between the transfer equipment and the tank vehicle or tank car required to operate the secondary control shall be functionally

compatible.

- 32.6.5.1.10.1 **Dry disconnect coupling.** When bottom loading a tank vehicle, the coupling between the liquid loading hose or pipe and the truck piping shall be a dry disconnect coupling.
- 32.6.5.1.10.2 **Venting.** When bottom loading a tank vehicle or tank car that is equipped for vapor control and vapor control is not used, the tank shall be vented to the atmosphere to prevent pressurization of the tank. Such venting shall be at a height equal to or greater than the top of the cargo tank.
- 32.6.5.1.10.3 **Vapor-tight connection.** Connections to the plant vapor control system shall be designed to prevent the escape of vapor to the atmosphere when not connected to a tank vehicle or tank car.
- 32.6.5.1.10.4 **Vapor-processing equipment.** Vapor-processing equipment shall be separated from above-ground tanks, warehouses, other plant buildings, transfer facilities or nearest lot line of adjoining property that can be built on by a distance of at least 7.6 m. Vapor-processing equipment shall be protected from physical damage by remote location, guardrails, curbs or fencing.
- 32.6.5.1.11 **Switch loading.** Tank vehicles or tank cars which have previously contained Class I liquids shall not be loaded with Class II or III liquids until such vehicles and all piping, pumps, hoses and meters connected thereto have been completely drained and flushed.
- 32.6.5.1.12 **Loading racks.** Where provided, loading racks, stairs or platforms shall be constructed of noncombustible materials. Buildings for pumps or for shelter of loading personnel are allowed to be part of the loading rack. Wiring and electrical equipment located within 7.6 m of any portion of the loading rack shall be in accordance with Section 32.3.1.1.
- 32.6.5.1.13 **Transfer apparatus.** Bulk and process transfer apparatus shall be of an approved type.
- 32.6.5.1.14 **Inside buildings.** Tank vehicles and tank cars shall not be located inside a building while transferring Class I, II or IIIA liquids, unless approved by the building code official.  
**Exception:** Tank vehicles are allowed under weather protection canopies and canopies of automobile motor vehicle fuel-dispensing stations.
- 32.6.5.1.15 **Tank vehicle and tank car certification.** Certification shall be maintained for tank vehicles and tank cars in accordance with MOI requirements.
- 32.6.5.1.16 **Tank vehicle and tank car stability.** Tank vehicles and tank cars shall be stabilized against movement during loading and unloading in accordance with Sections 32.6.5.1.16.1 through 32.6.5.1.16.3.
- 32.6.5.1.16.1 **Tank vehicles.** When the vehicle is parked for loading or unloading, the cargo trailer portion of the tank vehicle shall be secured in a manner that will prevent unintentional movement.
- 32.6.5.1.16.2 **Chock blocks.** At least two chock blocks not less than 130 mm by 130 mm by 300 mm in size and dished to fit the contour of the tires shall be used during transfer operations of tank vehicles.
- 32.6.5.1.16.3 **Tank cars.** Brakes shall be set and the wheels shall be blocked to prevent rolling.
- 32.6.5.1.17 **Monitoring.** Transfer operations shall be monitored by an approved monitoring system or by an attendant. When monitoring is by an attendant, the operator or other competent person shall be present at all times.
- 32.6.5.1.18 **Security.** Transfer operations shall be surrounded by a noncombustible fence not less than 1.5 m in height. Tank vehicles and tank cars shall not be loaded or unloaded unless such vehicles are entirely within the fenced area.

**Exceptions:**

1. Motor fuel-dispensing facilities complying with Chapter 20.
2. Installations where adequate public safety exists because of isolation, natural barriers or other factors as determined appropriate by the building code official.
3. Facilities or properties that are entirely enclosed or protected from entry.

**32.6.5.2 Bulk transfer.** Bulk transfer shall be in accordance with Sections 32.6.5.1 and 32.6.5.2.1.

**32.6.5.2.1 Vehicle motor.** Motors of tank vehicles or tank cars shall be shutoff during the making and breaking of hose connections and during the unloading operation.

**Exception:** Where unloading is performed with a pump deriving its power from the tank vehicle motor.

**32.6.5.3 Process transfer.** Process transfer shall be in accordance with Section 32.6.5.1 and Sections 32.6.5.3.1 through 32.6.5.3.3.

**32.6.5.3.1 Piping, valves, hoses and fittings.** Piping, valves, hoses and fittings which are not a part of the tank vehicle or tank car shall be in accordance with Section 32.3.6. Caps or plugs which prevent leakage or spillage shall be provided at all points of connection to transfer piping.

**32.6.5.3.1.1 Shutoff valves.** Approved automatically or manually activated shutoff valves shall be provided where the transfer hose connects to the process piping, and on both sides of any exterior fire-resistance-rated wall through which the piping passes. Manual shutoff valves shall be arranged so that they are accessible from grade. Valves shall not be locked in the open position.

**32.6.5.3.1.2 Hydrostatic relief.** Hydrostatic pressure-limiting or relief devices shall be provided where pressure buildup in trapped sections of the system could exceed the design pressure of the components of the system. Devices shall relieve to other portions of the system or to another approved location.

**32.6.5.3.1.3 Antisiphon valves.** Antisiphon valves shall be provided when the system design would allow siphonage.

**32.6.5.3.2 Vents.** Normal and emergency vents shall be maintained operable at all times.

**32.6.5.3.3 Motive power.** Motors of tank vehicles or tank cars shall be shutoff during the making and breaking of hose connections and during the unloading operation. **Exception:** When unloading is performed with a pump deriving its power from the tank vehicle motor.

**32.6.5.4 Dispensing from tank vehicles and tank cars.** Dispensing from tank vehicles and tank cars into the fuel tanks of motor vehicles shall be prohibited unless allowed by and conducted in accordance with Sections 32.6.5.4.1 through 32.6.5.4.4.

**32.6.5.4.1 Marine craft and special equipment.** Liquids intended for use as motor fuels are allowed to be transferred from tank vehicles into the fuel tanks of marine craft and special equipment when approved by the building code official, and when:

1. The tank vehicle's specific function is that of supplying fuel to fuel tanks.
2. The operation is not performed where the public has access or where there is unusual exposure to life and property.
3. The dispensing line does not exceed 15.2 m in length.
4. The dispensing nozzle is approved.

**32.6.5.4.2 Emergency refueling.** When approved by the building code official, dispensing of motor vehicle fuel from tank vehicles into the fuel tanks of motor vehicles is allowed during emergencies. Dispensing from tank vehicles shall be in accordance with Sections 32.6.2.8 and 32.6.6.

- 32.6.5.4.3 Aircraft fueling.** Transfer of liquids from tank vehicles to the fuel tanks of aircraft shall be in accordance with Chapter 11.
- 32.6.5.4.4 Fueling of vehicles at farms, construction sites and similar areas.** Transfer of liquid from tank vehicles to motor vehicles for private use on farms and rural areas and at construction sites, earthmoving projects, gravel pits and borrow pits is allowed in accordance with Section 32.6.2.8.
- 32.6.5.4.5 Commercial, industrial, governmental or manufacturing.** Dispensing of Class II and III motor vehicle fuel from tank vehicles into the fuel tanks of motor vehicles located at commercial, industrial, governmental or manufacturing establishments is allowed where permitted, provided such dispensing operations are conducted in accordance with the following:
1. Dispensing shall occur only at sites that have been permitted to conduct mobile fueling.
  2. The owner of a mobile fueling operation shall provide to the jurisdiction a written response plan which demonstrates readiness to respond to a fuel spill and carry out appropriate mitigation measures, and describes the process to dispose properly of contaminated materials.
  3. A detailed site plan shall be submitted with each application for a permit. The site plan shall indicate: all buildings, structures and appurtenances on site and their use or function; all uses adjacent to the property lines of the site; the locations of all storm drain openings, adjacent waterways or wetlands; information regarding slope, natural drainage, curbing, impounding and how a spill will be retained upon the site property; and the scale of the site plan. Provisions shall be made to prevent liquids spilled during dispensing operations from flowing into buildings or off-site. Acceptable methods include, but shall not be limited to, grading driveways, raising doorsills or other approved means.
  4. The building code official is allowed to impose limits on the times and/or days during which mobile fueling operations may take place, and specific locations on a site where fueling is permitted.
  5. Mobile fueling operations shall be conducted in areas not accessible to the public or shall be limited to times when the public is not present.
  6. Mobile fueling shall not take place within 4.6 m of buildings, property lines or combustible storage.
  7. The tank vehicle shall comply with the requirements of NFPA 385 and local requirements. The tank vehicle's specific functions shall include that of supplying fuel to motor vehicle fuel tanks. The vehicle and all its equipment shall be maintained in good repair.
  8. Signs prohibiting smoking or open flames within 7.6 m of the tank vehicle or the point of fueling shall be prominently posted on three sides of the vehicle including the back and both sides.
  9. A portable fire extinguisher with a minimum rating of 40:BC shall be provided on the vehicle with signage clearly indicating its location.
  10. The dispensing nozzles and hoses shall be of an approved and listed type.
  11. The dispensing hose shall not be extended from the reel more than 30.5 m in length.
  12. Absorbent materials, nonwater-absorbent pads, a 3 m-long containment boom, an approved container with lid and a nonmetallic shovel shall be provided to mitigate a minimum 19 L fuel spill.
  13. Tank vehicles shall be equipped with a "fuel limit" switch such as a count-back switch, to limit the amount of a single fueling operation to a maximum of

1893 L before resetting the limit switch.

**Exception:** Tank vehicles where the operator carries and can utilize a remote emergency shutoff device which, when activated, immediately causes flow of fuel from the tank vehicle to cease.

14. Persons responsible for dispensing operations shall be trained in the appropriate mitigating actions in the event of a fire, leak or spill. Training records shall be maintained by the dispensing company and shall be made available to the building code official upon request.
15. Operators of tank vehicles used for mobile fueling operations shall have in their possession at all times an emergency communications device to notify the proper authorities in the event of an emergency.
16. The tank vehicle dispensing equipment shall be constantly attended and operated only by designated personnel who are trained to handle and dispense motor fuels.
17. Prior to beginning dispensing operations, precautions shall be taken to ensure ignition sources are not present.
18. The engines of vehicles being fueled shall be shutoff during dispensing operations.
19. Nighttime fueling operations shall only take place in adequately lighted areas.
20. The tank vehicle shall be positioned with respect to vehicles being fueled to prevent traffic from driving over the delivery hose.
21. During fueling operations, tank vehicle brakes shall be set, chock blocks shall be in place and warning lights shall be in operation.
22. Motor vehicle fuel tanks shall not be topped off.
23. The dispensing hose shall be properly placed on an approved reel or in an approved compartment prior to moving the tank vehicle.
24. The building code official and other appropriate authorities shall be notified when a reportable spill or unauthorized discharge occurs.

**32.6.6 Tank vehicles and vehicle operation.** Tank vehicles shall be designed, constructed, equipped and maintained in accordance with NFPA 385 and Sections 32.6.6.1 through 32.6.6.4.

**32.6.6.1 Operation of tank vehicles.** Tank vehicles shall be utilized and operated in accordance with NFPA 385 and Sections 32.6.6.1.1 through 32.6.6.1.11.

**32.6.6.1.1 Vehicle maintenance.** Tank vehicles shall not be operated unless they are in proper state of repair and free from accumulation of grease, oil or other flammable substance, and leaks.

**32.6.6.1.2 Leaving vehicle unattended.** The driver, operator or attendant of a tank vehicle shall not remain in the vehicle cab and shall not leave the vehicle while it is being filled or discharged. The delivery hose, when attached to a tank vehicle, shall be considered to be a part of the tank vehicle.

**32.6.6.1.3 Vehicle motor shutdown.** Motors of tank vehicles or tractors shall be shutdown during the making or breaking of hose connections. If loading or unloading is performed without the use of a power pump, the tank vehicle or tractor motor shall be shutdown throughout such operations.

**32.6.6.1.4 Outage.** A cargo tank or compartment thereof used for the transportation of flammable or combustible liquids shall not be loaded to absolute capacity. The vacant space in a cargo tank or compartment thereof used in the transportation of flammable or combustible liquids shall not be less than 1 percent. Sufficient space shall be left vacant to prevent leakage from or distortion of such tank or compartment by expansion of the contents caused by rise in temperature in transit.

- 32.6.6.1.5 Overfill protection.** The driver, operator or attendant of a tank vehicle shall, before making delivery to a tank, determine the unfilled capacity of such tank by a suitable gauging device. To prevent overfilling, the driver, operator or attendant shall not deliver in excess of that amount.
- 32.6.6.1.6 Securing hatches.** During loading, hatch covers shall be secured on all but the receiving compartment.
- 32.6.6.1.7 Liquid temperature.** Materials shall not be loaded into or transported in a tank vehicle at a temperature above the material's ignition temperature unless safeguarded in an approved manner.
- 32.6.6.1.8 Bonding to underground tanks.** An external bond-wire connection or bond-wire integral with a hose shall be provided for the transferring of flammable liquids through open connections into underground tanks.
- 32.6.6.1.9 Smoking.** Smoking by tank vehicle drivers, helpers or other personnel is prohibited while they are driving, making deliveries, filling or making repairs to tank vehicles.
- 32.6.6.1.10 Hose connections.** Delivery of flammable liquids to underground tanks with a capacity of more than 3,785 L shall be made by means of approved liquid and vapor-tight connections between the delivery hose and fill tank pipe. Where underground tanks are equipped with any type of vapor recovery system, all connections required to be made for the safe and proper functioning of the particular vapor recovery process shall be made. Such connections shall be made liquid and vapor tight and remain connected throughout the unloading process. Vapors shall not be discharged at grade level during delivery.
- 32.6.6.1.10.1 Simultaneous delivery.** Simultaneous delivery to underground tanks of any capacity from two or more discharge hoses shall be made by means of mechanically tight connections between the hose and fill pipe.
- 32.6.6.1.11 Hose protection.** Upon arrival at a point of delivery and prior to discharging any flammable or combustible liquids into underground tanks, the driver, operator or attendant of the tank vehicle shall ensure that all hoses utilized for liquid delivery and vapor recovery, where required, will be protected from physical damage by motor vehicles. Such protection shall be provided by positioning the tank vehicle to prevent motor vehicles from passing through the area or areas occupied by hoses, or by other approved equivalent means.
- 32.6.6.2 Parking.** Parking of tank vehicles shall be in accordance with Sections 32.6.6.2.1 through 32.6.6.2.3.
- Exception:** In cases of accident, breakdown or other emergencies, tank vehicles are allowed to be parked and left unattended at any location while the operator is obtaining assistance.
- 32.6.6.2.1 Parking near residential, educational and institutional occupancies and other high-risk areas.** Tank vehicles shall not be left unattended at any time on residential streets, or within 152 m of a residential area, apartment or hotel complex, educational facility, hospital or care facility. Tank vehicles shall not be left unattended at any other place that would, in the opinion of the fire chief, pose an extreme life hazard.
- 32.6.6.2.2 Parking on thoroughfares.** Tank vehicles shall not be left unattended on a public street, highway, public avenue or public alley.
- Exceptions:**
1. The necessary absence in connection with loading or unloading the vehicle. During actual fuel transfer, Section 32.6.6.1.2 shall apply. The vehicle location shall be in accordance with Section 32.6.6.2.1.



2. Stops for meals during the day or night, if the street is well lighted at the point of parking. The vehicle location shall be in accordance with Section 32.6.6.2.1.
- 32.6.6.2.3 Duration exceeding 1 hour.** Tank vehicles parked at one point for longer than 1 hour shall be located off of public streets, highways, public avenues or alleys, and:
1. Inside of a bulk plant and either 7.6 m or more from the nearest lot line or within a building approved for such use; or
  2. At other approved locations not less than 15.2 m from the buildings other than those approved for the storage or servicing of such vehicles.
- 32.6.6.3 Garaging.** Tank vehicles shall not be parked or garaged in buildings other than those specifically approved for such use by the building code official.
- 32.6.6.4 Fire protection.** Tank vehicles shall be equipped with a fire extinguisher complying with Section 7.6 and having a minimum rating of 2-A:20-B:C. During unloading of the tank vehicle, the fire extinguisher shall be out of the carrying device on the vehicle and shall be 4.6 m or more from the unloading valves.
- 32.6.7 Refineries.** Plants and portions of plants in which flammable liquids are produced on a scale from crude petroleum, natural gasoline or other hydrocarbon sources shall be in accordance with Sections 32.6.7.1 through 32.6.7.3. Petroleum-processing plants and facilities or portions of plants or facilities in which flammable or combustible liquids are handled, treated or produced on a commercial scale from crude petroleum, natural gasoline, or other hydrocarbon sources shall also be in accordance with API 651, API 653, API 752, API 1615, API 2001, API 2003, API 2009, API 2015, API RP2023, API 2201 and API 2350.
- 32.6.7.1 Corrosion protection.** Above-ground tanks and piping systems shall be protected against corrosion in accordance with API 651.
- 32.6.7.2 Cleaning of tanks.** The safe entry and cleaning of petroleum storage tanks shall be conducted in accordance with API 2015.
- 32.6.7.3 Storage of heated petroleum products.** Where petroleum-derived asphalts and residues are stored in heated tanks at refineries and bulk storage facilities or in tank vehicles, such products shall be in accordance with API 2023.
- 32.6.8 Vapor recovery and vapor-processing systems.** Vapor-processing systems in which the vapor source operates at pressures from vacuum, up to and including 6.9 kPa or in which a potential exists for vapor mixtures in the flammable range, shall comply with Sections 32.6.8.1 through 32.6.8.5.
- Exceptions:**
1. Marine systems complying with local transportation regulations such as MOT.
  2. Motor fuel-dispensing facility systems complying with Chapter 20.
- 32.6.8.1 Over-pressure/vacuum protection.** Tanks and equipment shall have independent venting for over-pressure or vacuum conditions that might occur from malfunction of the vapor recovery or processing system.
- Exception:** For tanks, venting shall comply with Section 32.4.2.7.3.
- 32.6.8.2 Vent location.** Vents on vapor-processing equipment shall be not less than 3.7 m from adjacent ground level, with outlets located and directed so that flammable vapors will disperse to below the lower flammable limit (LFL) before reaching locations containing potential ignition sources.
- 32.6.8.3 Vapor collection systems and overfill protection.** The design and operation of the vapor collection system and overfill protection shall be in accordance with this section and NFPA 30.

- 32.6.8.4 Liquid-level monitoring.** A liquid knock-out vessel used in the vapor collection system shall have means to verify the liquid level and a high-liquid-level sensor that activates an alarm. For unpopulated facilities, the high-liquid-level sensor shall initiate the shutdown of liquid transfer into the vessel and shutdown of vapor recovery or vapor-processing systems.
- 32.6.8.5 Overfill protection.** Storage tanks served by vapor recovery or processing systems shall be equipped with overfill protection in accordance with Section 32.4.2.7.5.8.

## CHAPTER 33 FLAMMABLE GASES

### SECTION 33.1 GENERAL

- 33.1.1 Scope.** The storage and use of flammable gases shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 28. Gaseous hydrogen systems at consumer sites shall also comply with NFPA 50A.

**Exceptions:**

1. Gases used as refrigerants in refrigeration systems (see Section 5D.6).
2. Liquefied petroleum gases and natural gases regulated by Chapter 36.
3. Fuel-gas systems and appliances.
4. Hydrogen motor fuel-dispensing stations designed and constructed in accordance with Chapter 20.

- 33.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 33.2 DEFINITIONS

- 33.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**FLAMMABLE GAS.** A material which is a gas at 20°C or less at 101 kPa of pressure [a material that has a boiling point of 20°C or less at 101 kPa] which:

1. Is ignitable at 101 kPa when in a mixture of 13 percent or less by volume with air; or
2. Has a flammable range at 101 kPa with air of at least 12 percent, regardless of the lower limit.

The limits specified shall be determined at 101 kPa of pressure and a temperature of 20°C in accordance with ASTM E 681.

**FLAMMABLE LIQUEFIED GAS.** A liquefied compressed gas which, under a charged pressure, is partially liquid at a temperature of 20°C and which is flammable.

### SECTION 33.3 GENERAL REQUIREMENTS

- 33.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of flammable gases in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3, 33.1 and 33.3.

- 33.3.1.1 Special limitations for indoor storage and use.** Flammable gases shall not be stored or used in Group A, B, E, I or R occupancies.

**Exceptions:**

1. Cylinders not exceeding a capacity of 7.08 m<sup>3</sup> each at normal temperature and pressure (NTP) used for maintenance purposes, patient care or operation of equipment.
2. Food service operations in accordance with Section 36.3.2.1.7.

- 33.3.1.1.1 Medical gases.** Medical gas system supply cylinders shall be located in medical gas storage rooms or gas cabinets as set forth in Section 28.6.
- 33.3.1.1.2 Aggregate quantity.** The aggregate quantities of flammable gases used for maintenance purposes and operation of equipment shall not exceed the maximum allowable quantity per control area indicated in Table 25.3.1.1(1).
- 33.3.1.2 Storage containers.** Cylinders and pressure vessels for flammable gases shall be designed, constructed, installed, tested and maintained in accordance with Chapter 28.
- 33.3.1.3 Emergency shutoff.** Compressed gas systems conveying flammable gases shall be provided with approved emergency shutoff valves that can be activated at each point of use and each source.
- 33.3.1.4 Ignition source control.** Ignition sources in areas containing flammable gases shall be controlled in accordance with Section 25.3.7.  
Static-producing equipment located in flammable gas storage areas shall be grounded.  
“No Smoking” signs shall be posted in areas containing flammable gases in accordance with Section 25.3.6.
- 33.3.1.5 Liquefied flammable gases and flammable gases in solution.** Containers of liquefied flammable gases and flammable gases in solution shall be positioned in the upright position or positioned so that the pressure relief valve is in direct contact with the vapor space of the container.  
**Exceptions:**
1. Containers of flammable gases in solution with a capacity of 5 L or less.
  2. Containers of flammable liquefied gases, with a capacity not exceeding 5 L, designed to preclude the discharge of liquid from safety relief devices.
- 33.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of flammable gases in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

## SECTION 33.4 STORAGE

- 33.4.1 Indoor storage.** Indoor storage of flammable gases in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1), shall be in accordance with Sections 25.1, 25.3 and 25.4, and this chapter.
- 33.4.1.1 Explosion control.** Buildings or portions thereof containing flammable gases shall be provided with explosion control in accordance with Section 7.11.
- 33.4.2 Outdoor storage.** Outdoor storage of flammable gases in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3 and 25.4, and this chapter.
- 33.4.2.1 Outdoor storage areas.** Outdoor storage areas for flammable gases shall be located in accordance with Table 33.4.2.1.

## SECTION 33.5 USE

- 33.5.1 General.** The use of flammable gases in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1.2(3) shall be in accordance with Sections 25.1, 25.3 and 25.5, and this chapter.

**TABLE 33.4.2.1****FLAMMABLE GASES DISTANCE FROM OUTDOOR STORAGE AREAS TO EXPOSURES<sup>a</sup>**

<b>AGGREGATE QUANTITY PER STORAGE AREA (cubic meters)</b>	<b>MINIMUM DISTANCE TO BUILDINGS, PUBLIC STREETS, PUBLIC ALLEYS, PUBLIC WAYS OR LOT LINES (meters)</b>	<b>MINIMUM DISTANCE BETWEEN STORAGE AREAS (meters)</b>
0-120	1.5	1.5
121-598	3.1	3.1
599-1,436	4.6	4.6
1,437-2,393	6.1	4.6
2,394 or greater	7.6	6.1

- a. The minimum required distances shall be reduced to 1.5 m when protective structures having a minimum fire-resistance rating of 2 hours interrupt the line of sight between the container and the exposure. The protective structure shall be at least 1.52 m from the exposure. The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

## CHAPTER 34 FLAMMABLE SOLIDS

### SECTION 34.1 GENERAL

- 34.1.1 Scope.** The storage and use of flammable solids shall be in accordance with this chapter.
- 34.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 34.2 DEFINITIONS

- 34.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**FLAMMABLE SOLID.** A solid, other than a blasting agent or explosive, that is capable of causing fire through friction, absorption or moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which has an ignition temperature below 100°C or which burns so vigorously and persistently when ignited as to create a serious hazard. A chemical shall be considered a flammable solid as determined in accordance with the test method of CPSC 16 CFR; Part 1500.44, if it ignites and burns with a self-sustained flame at a rate greater than 2.5 mm/s along its major axis.

**MAGNESIUM.** The pure metal and alloys, of which the major part is magnesium.

### SECTION 34.3 GENERAL REQUIREMENTS

- 34.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of flammable solids in amounts not exceeding the maximum allowable quantity per control area as indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3 and 34.1.
- 34.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of flammable solids exceeding the maximum allowable quantity per control area as indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

### SECTION 34.4 STORAGE

- 34.4.1 Indoor storage.** Indoor storage of flammable solids in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.
- 34.4.1.1 Pile size limits and location.** Flammable solids stored in quantities greater than 28 m<sup>3</sup> shall be separated into piles each not larger than 28 m<sup>3</sup>.
- 34.4.1.2 Aisles.** Aisle widths between piles shall not be less than the height of the piles or 1.2 m, whichever is greater.

- 34.4.1.3 Basement storage.** Flammable solids shall not be stored in basements.
- 34.4.2 Outdoor storage.** Outdoor storage of flammable solids in amounts exceeding the maximum allowable quantities per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter. Outdoor storage of magnesium shall be in accordance with Section 34.6.
- 34.4.2.1 Distance from storage to exposures.** Outdoor storage of flammable solids shall not be located within 6.1 m of a building, lot line, public street, public alley, public way or means of egress. A 2 hour fire barrier without openings or penetrations and extending 760 mm above and to the sides of the storage area is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.
- 34.4.2.2 Pile size limits.** Outdoor storage of flammable solids shall be separated into piles not larger than 141 m<sup>3</sup> each. Piles shall be separated by aisles with a minimum width of not less than one-half the pile height or 3.1 m, whichever is greater.

## SECTION 34.5 USE

- 34.5.1 General.** The use of flammable solids in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter. The use of magnesium shall be in accordance with Section 34.6.

## SECTION 34.6 MAGNESIUM

- 34.6.1 General.** Storage, use, handling and processing of magnesium, including the pure metal and alloys of which the major part is magnesium, shall be in accordance with Chapter 25 and this section.
- 34.6.2 Storage of magnesium articles.** The storage of magnesium shall comply with Sections 34.6.2.1 through 34.6.4.3.
- 34.6.2.1 Storage of greater than 1.4 cubic meters.** Magnesium storage in quantities greater than 1.4 m<sup>3</sup> shall be separated from storage of other materials that are either combustible or in combustible containers by aisles. Piles shall be separated by aisles with a minimum width of not less than the pile height.
- 34.6.2.2 Storage of greater than 28 cubic meters.** Magnesium storage in quantities greater than 28 m<sup>3</sup> shall be separated into piles not larger than 28 m<sup>3</sup> each. Piles shall be separated by aisles with a minimum width of not less than the pile height. Such storage shall not be located in nonsprinklered buildings of Type III, IV or V construction, as defined in the SBC 201.
- 34.6.2.3 Storage in combustible containers or within 9.1 meters of other combustibles.** Where in nonsprinklered buildings of Type III, IV or V construction, as defined in the SBC 201, magnesium shall not be stored in combustible containers or within 9.1 m of other combustibles.
- 34.6.2.4 Storage in foundries and processing plants.** The size of storage piles of magnesium articles in foundries and processing plants shall not exceed 25 m<sup>3</sup>. Piles shall be separated by aisles with a minimum width of not less than one-half the pile height.

- 34.6.3 Storage of pigs, ingots and billets.** The storage of magnesium pigs, ingots and billets shall comply with Sections 34.6.3.1 and 34.6.3.2.
- 34.6.3.1 Indoor storage.** Indoor storage of pigs, ingots and billets shall only be on floors of noncombustible construction. Piles shall not be larger than 226.8 metric tons each. Piles shall be separated by aisles with a minimum width of not less than one-half the pile height.
- 34.6.3.2 Outdoor storage.** Outdoor storage of magnesium pigs, ingots and billets shall be in piles not exceeding 453.6 metric tons each. Piles shall be separated by aisles with a minimum width of not less than one-half the pile height. Piles shall be separated from combustible materials or buildings on the same or adjoining property by a distance of not less than the height of the nearest pile.
- 34.6.4 Storage of fine magnesium scrap.** The storage of scrap magnesium shall comply with Sections 34.6.4.1 through 34.6.4.3.
- 34.6.4.1 Separation.** Magnesium fines shall be kept separate from other combustible materials.
- 34.6.4.2 Storage of 1.4 to 28 cubic meters.** Storage of fine magnesium scrap in quantities greater than 1.4 m<sup>3</sup> [208 L steel drums] shall be separated from other occupancies by an open space of at least 15.2 m or by a fire barrier constructed in accordance with these code requirements.
- 34.6.4.3 Storage of greater than 28 cubic meters.** Storage of fine magnesium scrap in quantities greater than 28 m<sup>3</sup> shall be separated from all buildings other than those used for magnesium scrap recovery operations by a distance of not less than 30.5 m.
- 34.6.5 Use of magnesium.** The use of magnesium shall comply with Sections 34.6.5.1 through 34.6.5.8.
- 34.6.5.1 Melting pots.** Floors under and around melting pots shall be of noncombustible construction.
- 34.6.5.2 Heat-treating ovens.** Approved means shall be provided for control of magnesium fires in heat-treating ovens.
- 34.6.5.3 Dust collection.** Magnesium grinding, buffing and wire-brushing operations, other than rough finishing of castings, shall be provided with approved hoods or enclosures for dust collection which are connected to a liquid-precipitation type of separator that converts dust to sludge without contact (in a dry state) with any high-speed moving parts.
- 34.6.5.3.1 Duct construction.** Connecting ducts or suction tubes shall be completely grounded, as short as possible, and without bends. Ducts shall be fabricated and assembled with a smooth interior, with internal lap joints pointing in the direction of airflow and without unused capped side outlets, pockets or other dead-end spaces which allow an accumulation of dust.
- 34.6.5.3.2 Independent dust separators.** Each machine shall be equipped with an individual dust-separating unit.
- Exceptions:**
1. One separator is allowed to serve two dust-producing units on multiunit machines.
  2. One separator is allowed to serve not more than four portable dust-producing units in a single enclosure or stand.
- 34.6.5.4 Power supply interlock.** Power supply to machines shall be interlocked with exhaust airflow, and liquid pressure level or flow. The interlock shall be designed to shutdown the machine it serves when the dust removal or separator system is not operating properly.



- 34.6.5.5 Electrical equipment.** Electric wiring, fixtures and equipment in the immediate vicinity of and attached to dust-producing machines, including those used in connection with separator equipment, shall be of approved types and shall be approved for use in Class II, Division 1 hazardous locations in accordance with the SBC 401.
- 34.6.5.6 Grounding.** Equipment shall be securely grounded by permanent ground wires in accordance with the SBC 401.
- 34.6.5.7 Fire-extinguishing materials.** Fire-extinguishing materials shall be provided for every operator performing machining, grinding or other processing operation on magnesium as follows:
- 1.** Within 9.1 m, a supply of extinguishing materials in an approved container with a hand scoop or shovel for applying the material; or
  - 2.** Within 23 m, a portable fire extinguisher complying with Section 7.6.
- All extinguishing materials shall be approved for use on magnesium fires. Where extinguishing materials are stored in cabinets or other enclosed areas, the enclosures shall be openable without the use of a key or special knowledge.
- 34.6.5.8 Collection of chips, turnings and fines.** Chips, turnings and other fine magnesium scrap shall be collected from the pans or spaces under machines and from other places where they collect at least once each working day. Such material shall be placed in a covered, vented steel container and removed to an approved location.

## CHAPTER 35 HIGHLY TOXIC AND TOXIC MATERIALS

### SECTION 35.1 GENERAL

**35.1.1 Scope.** The storage and use of highly toxic and toxic materials shall comply with this chapter. Compressed gases shall also comply with Chapter 28.

**Exceptions:**

1. Display and storage in Group M and storage in Group S occupancies complying with Section 25.3.11.
2. Conditions involving pesticides or agricultural products as follows:
  - 2.1 Application and release of pesticide, agricultural products and materials intended for use in weed abatement, erosion control, soil amendment or similar applications when applied in accordance with the manufacturer's instruction and label directions.
  - 2.2 Transportation of pesticides in compliance with the local Hazardous Materials Transportation Act and regulations there under.
  - 2.3 Storage in dwellings or private garages of pesticides registered by the Saudi Environmental Protection Agency to be utilized in and around the home, garden, pool, spa and patio.

**35.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 35.2 DEFINITIONS

**35.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**CONTAINMENT SYSTEM.** A gas-tight recovery system comprised of equipment or devices which can be placed over a leak in a compressed gas container, thereby stopping or controlling the escape of gas from the leaking container.

**CONTAINMENT VESSEL.** A gas-tight recovery vessel designed so that a leaking compressed gas container can be placed within its confines thereby, encapsulating the leaking container.

**EXCESS FLOW VALVE.** A valve inserted into a compressed gas cylinder, portable tank or stationary tank that is designed to positively shutoff the flow of gas in the event that its predetermined flow is exceeded.

**HIGHLY TOXIC.** A material which produces a lethal dose or lethal concentration which falls within any of the following categories:

1. A chemical that has a median lethal dose ( $LD_{50}$ ) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 g each.
2. A chemical that has a median lethal dose ( $LD_{50}$ ) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of

albino rabbits weighing between 2 and 3 kilograms each.

3. A chemical that has a median lethal concentration ( $LC_{50}$ ) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume or dust, when administered by continuous inhalation for one hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 g each.

Mixtures of these materials with ordinary materials, such as water, might not warrant classification as highly toxic. While this system is basically simple in application, any hazard evaluation that is required for the precise categorization of this type of material shall be performed by experienced, technically competent persons.

**OZONE-GAS GENERATOR.** Equipment which causes the production of ozone.

**REDUCED FLOW VALVE.** A valve equipped with a restricted flow orifice and inserted into a compressed gas cylinder, portable tank or stationary tank that is designed to reduce the maximum flow from the valve under full-flow conditions. The maximum flow rate from the valve is determined with the valve allowed to flow to atmosphere with no other piping or fittings attached.

**TOXIC.** A chemical falling within any of the following categories:

1. A chemical that has a median lethal dose ( $LD_{50}$ ) of more than 50 milligrams per kilogram, but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose ( $LD_{50}$ ) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration ( $LC_{50}$ ) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

### SECTION 35.3

#### HIGHLY TOXIC AND TOXIC SOLIDS AND LIQUIDS

- 35.3.1 Indoor storage and use.** The indoor storage and use of highly toxic and toxic materials shall comply with Sections 35.3.1.1 through 35.3.1.5.3.
- 35.3.1.1 Quantities not exceeding the maximum allowable quantity per control area.** The indoor storage or use of highly toxic and toxic solids or liquids in amounts not exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(2) shall be in accordance with Sections 25.1, 25.3 and 35.1.
- 35.3.1.2 Quantities exceeding the maximum allowable quantity per control area.** The indoor storage or use of highly toxic and toxic solids or liquids in amounts exceeding the maximum allowable quantity per control area set forth in Table 25.3.1.1(2) shall be in accordance with Sections 35.1 through 35.3.1.3 and Chapter 25.

- 35.3.1.3 Treatment system—highly toxic liquids.** Exhaust scrubbers or other systems for processing vapors of highly toxic liquids shall be provided where a spill or accidental release of such liquids can be expected to release highly toxic vapors at normal temperature and pressure. Treatment systems and other processing systems shall be installed in accordance with the SBC 501.
- 35.3.1.4 Indoor storage.** Indoor storage of highly toxic and toxic solids and liquids shall comply with Sections 35.3.1.4.1 and 35.3.1.4.2.
- 35.3.1.4.1 Floors.** In addition to the requirements set forth in Section 25.4.12, floors of storage areas shall be of liquid-tight construction.
- 35.3.1.4.2 Separation—highly toxic solids and liquids.** In addition to the requirements set forth in Section 25.3.9.8, highly toxic solids and liquids in storage shall be located in approved hazardous material storage cabinets or isolated from other hazardous material storage by construction in accordance with the SBC 201.
- 35.3.1.5 Indoor use.** Indoor use of highly toxic and toxic solids and liquids shall comply with Sections 35.3.1.5.1 through 35.3.1.5.3.
- 35.3.1.5.1 Liquid transfer.** Highly toxic and toxic liquids shall be transferred in accordance with Section 25.5.1.10.
- 35.3.1.5.2 Exhaust ventilation for open systems.** Mechanical exhaust ventilation shall be provided for highly toxic and toxic liquids used in open systems in accordance with Section 25.5.2.1.1.  
**Exception:** Liquids or solids that do not generate highly toxic or toxic fumes, mists or vapors.
- 35.3.1.5.3 Exhaust ventilation for closed systems.** Mechanical exhaust ventilation shall be provided for highly toxic and toxic liquids used in closed systems in accordance with Section 25.5.2.2.2.  
**Exception:** Liquids or solids that do not generate highly toxic or toxic fumes, mists or vapors.
- 35.3.2 Outdoor storage and use.** Outdoor storage and use of highly toxic and toxic materials shall comply with Sections 35.3.2.1 through 35.3.2.6.
- 35.3.2.1 Quantities not exceeding the maximum allowable quantity per control area.** The outdoor storage or use of highly toxic and toxic solids or liquids in amounts not exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(4) shall be in accordance with Sections 25.1, 25.3 and 35.1.
- 35.3.2.2 Quantities exceeding the maximum allowable quantity per control area.** The outdoor storage or use of highly toxic and toxic solids or liquids in amounts exceeding the maximum allowable quantity per control area set forth in Table 25.3.1.1(4) shall be in accordance with Sections 35.1 and 35.3.2 and Chapter 25.
- 35.3.2.3 General outdoor requirements.** The general requirements applicable to the outdoor storage of highly toxic or toxic solids and liquids shall be in accordance with Sections 35.3.2.3.1 and 35.3.2.3.2.
- 35.3.2.3.1 Location.** Outdoor storage or use of highly toxic or toxic solids and liquids shall not be located within 6.1 m of lot lines, public streets, public alleys, public ways, exit discharges or exterior wall openings. A 2 hours fire barrier wall without openings or penetrations extending not less than 760 mm above and to the sides of the storage is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.
- 35.3.2.3.2 Treatment system—highly toxic liquids.** Exhaust scrubbers or other systems for processing vapors of highly toxic liquid shall be provided where a spill or accidental release of such liquids can be expected to release highly toxic vapors at normal temperature and pressure (NTP). Treatment systems and other processing

systems shall be installed in accordance with the SBC 501.

- 35.3.2.4 Outdoor storage piles.** Outdoor storage piles of highly toxic and toxic solids and liquids shall be separated into piles not larger than  $71 \text{ m}^3$ . Aisle widths between piles shall not be less than one-half the height of the pile or 3.1 m, whichever is greater.
- 35.3.2.5 Outdoor storage weather protection for highly toxic liquids and solids.** Where overhead weather protection is provided for highly toxic liquids or solids, and the weather protection is attached to a building, the storage area shall either be equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1, or storage shall be in fire-resistance-rated containers. Weather protection shall be provided in accordance with Section 25.4.13.
- 35.3.2.6 Outdoor liquid transfer.** Highly toxic and toxic liquids shall be transferred in accordance with Section 25.5.1.10.

## SECTION 35.4 HIGHLY TOXIC AND TOXIC COMPRESSED GASES

- 35.4.1 General.** The storage and use of highly toxic and toxic compressed gases shall comply with this section.
- 35.4.1.1 Special limitations for indoor storage and use by occupancy.** The indoor storage and use of highly toxic and toxic compressed gases in certain occupancies shall be subject to the limitations contained in Sections 35.4.1.1.1 through 35.4.1.1.3.
- 35.4.1.1.1 Group A, E, I or U occupancies.** Toxic and highly toxic compressed gases shall not be stored or used within Group A, E, I or U occupancies.  
**Exception:** Cylinders not exceeding  $0.57 \text{ m}^3$  at normal temperature and pressure (NTP) are allowed within gas cabinets or fume hoods.
- 35.4.1.1.2 Group R occupancies.** Toxic and highly toxic compressed gases shall not be stored or used in Group R occupancies.
- 35.4.1.1.3 Offices, retail sales and classrooms.** Toxic and highly toxic compressed gases shall not be stored or used in offices, retail sales or classroom portions of Group B, F, M or S occupancies.  
**Exception:** In classrooms of Group B occupancies, cylinders with a capacity not exceeding  $0.57 \text{ m}^3$  at NTP are allowed in gas cabinets or fume hoods.
- 35.4.1.2 Gas cabinets.** Gas cabinets containing highly toxic or toxic compressed gases shall comply with Section 25.3.8.5 and the following requirements:
1. The average ventilation velocity at the face of gas cabinet access ports or windows shall not be less than 1.02 m/s with a minimum of 0.76 m/s at any point of the access port or window.
  2. Gas cabinets shall be connected to an exhaust system.
  3. Gas cabinets shall not be used as the sole means of exhaust for any room or area.
  4. The maximum number of cylinders located in a single gas cabinet shall not exceed three, except that cabinets containing cylinders not over 0.454 kg net contents are allowed to contain up to 100 cylinders.
  5. Gas cabinets required by Section 35.4.2 or 35.4.3 shall be equipped with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. Alternative fire-extinguishing systems shall not be used.
- 35.4.1.3 Exhausted enclosures.** Exhausted enclosures containing highly toxic or toxic compressed gases shall comply with Section 25.3.8.5 and the following requirements:

1. The average ventilation velocity at the face of the enclosure shall not be less than 1.02 m/s with a minimum of 0.76 m/s.
2. Exhausted enclosures shall be connected to an exhaust system.
3. Exhausted enclosures shall not be used as the sole means of exhaust for any room or area.
4. Exhausted enclosures required by Section 35.4.2 or 35.4.3 shall be equipped with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1. Alternative fire-extinguishing systems shall not be used.

**35.4.2 Indoor storage and use.** The indoor storage and use of highly toxic or toxic compressed gases shall be in accordance with Sections 35.4.2.1 through 35.4.2.2.10.3.

**35.4.2.1 Applicability.** The applicability of regulations governing the indoor storage and use of highly toxic and toxic compressed gases shall be as set forth in Sections 35.4.2.1.1 through 35.4.2.1.3.

**35.4.2.1.1 Quantities not exceeding the maximum allowable quantity per control area.** The indoor storage or use of highly toxic and toxic gases in amounts not exceeding the maximum allowable quantity per control area set forth in Table 25.3.1.1(2) shall be in accordance with Sections 25.1, 25.3, 35.1 and 35.4.1.

**35.4.2.1.2 Quantities exceeding the maximum allowable quantity per control area.** The indoor storage or use of highly toxic and toxic gases in amounts exceeding the maximum allowable quantity per control area set forth in Table 25.3.1.1(2) shall be in accordance with Sections 35.1, 35.4.1, 35.4.2 and Chapter 25.

**35.4.2.1.3 Ozone gas generators.** The indoor use of ozone gas-generating equipment shall be in accordance with Section 35.5.

**35.4.2.2 General indoor requirements.** The general requirements applicable to the indoor storage and use of highly toxic and toxic compressed gases shall be in accordance with Sections 35.4.2.2.1 through 35.4.2.2.10.3.

**35.4.2.2.1 Cylinder and tank location.** Cylinders shall be located within gas cabinets, exhausted enclosures or gas rooms. Portable and stationary tanks shall be located within gas rooms or exhausted enclosures.

**35.4.2.2.2 Ventilated areas.** The room or area in which gas cabinets or exhausted enclosures are located shall be provided with exhaust ventilation. Gas cabinets or exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

**35.4.2.2.3 Leaking cylinders and tanks.** One or more gas cabinets or exhausted enclosures shall be provided to handle leaking cylinders, containers or tanks.

**Exceptions:**

1. Where cylinders, containers or tanks are located within gas cabinets or exhausted enclosures.
2. Where approved containment vessels or containment systems are provided in accordance with all of the following:
  - 2.1 Containment vessels or containment systems shall be capable of fully containing or terminating a release.
  - 2.2 Trained personnel shall be available at an approved location.
  - 2.3 Containment vessels or containment systems shall be capable of being transported to the leaking cylinder, container or tank.

**35.4.2.2.3.1 Location.** Gas cabinets and exhausted enclosures shall be located in gas rooms and connected to an exhaust system.

**35.4.2.2.4 Local exhaust for portable tanks.** A means of local exhaust shall be provided to capture leaks from portable tanks. The local exhaust shall consist of portable ducts or collection systems designed to be applied to the site of a leak in a valve or fitting on the tank. The local exhaust system shall be located in a gas room.

Exhaust shall be directed to a treatment system in accordance with Section 35.4.2.2.7.

**35.4.2.2.5 Piping and controls—stationary tanks.** In addition to the requirements of Section 25.3.2.2, piping and controls on stationary tanks shall comply with the following requirements:

1. Pressure relief devices shall be vented to a treatment system designed in accordance with Section 35.4.2.2.7.

**Exception:** Pressure relief devices on outdoor tanks provided exclusively for relieving pressure due to fire exposure are not required to be vented to a treatment system provided that:

1. The material in the tank is not flammable.
  2. The tank is not located in a diked area with other tanks containing combustible materials.
  3. The tank is located not less than 9.1 m from combustible materials or structures or is shielded by a fire barrier complying with Section 35.4.3.2.1.1.
2. Filling or dispensing connections shall be provided with a means of local exhaust. Such exhaust shall be designed to capture fumes and vapors. The exhaust shall be directed to a treatment system in accordance with Section 35.4.2.2.7.
  3. Stationary tanks shall be provided with a means of excess flow control on all tank inlet or outlet connections.

**Exceptions:**

1. Inlet connections designed to prevent backflow.
2. Pressure relief devices.

**35.4.2.2.6 Gas rooms.** Gas rooms shall comply with Section 25.3.8.4 and both of the following requirements:

1. The exhaust ventilation from gas rooms shall be directed to an exhaust system.
2. Gas rooms shall be equipped with an approved automatic sprinkler system. Alternative fire-extinguishing systems shall not be used.

**35.4.2.2.7 Treatment systems.** The exhaust ventilation from gas cabinets, exhausted enclosures and gas rooms, and local exhaust systems required in Sections 35.4.2.2.4 and 35.4.2.2.5 shall be directed to a treatment system. The treatment system shall be utilized to handle the accidental release of gas and to process exhaust ventilation. The treatment system shall be designed in accordance with Sections 35.4.2.2.7.1 through 35.4.2.2.7.5 and Section 3.10 of the SBC 501.

**Exceptions:**

1. Highly toxic and toxic gases—storage. A treatment system is not required for cylinders, containers and tanks in storage when all of the following controls are provided:
  - 1.1 Valve outlets are equipped with gas-tight outlet plugs or caps.
  - 1.2 Hand wheel-operated valves have handles secured to prevent movement.
  - 1.3 Approved containment vessels or containment systems are provided in accordance with Section 35.4.2.2.3.
2. Toxic gases—use. Treatment systems are not required for toxic gases supplied by cylinders or portable tanks not exceeding 2,498 L liquid capacity when the following are provided:
  - 2.1 A gas detection system with a sensing interval not exceeding 5 minutes.
  - 2.2 An approved automatic-closing fail-safe valve located immediately adjacent to cylinder valves. The fail-safe valve shall close when gas is detected at the permissible exposure limit (PEL) by a gas detection

system monitoring the exhaust system at the point of discharge from the gas cabinet, exhausted enclosure, ventilated enclosure or gas room. The gas detection shall comply with Section 35.4.2.2.10.

- 35.4.2.2.7.1 Design.** Treatment systems shall be capable of diluting, adsorbing, absorbing, containing, neutralizing, burning or otherwise processing the contents of the largest single vessel of compressed gas. Where a total containment system is used, the system shall be designed to handle the maximum anticipated pressure of release to the system when it reaches equilibrium.
- 35.4.2.2.7.2 Performance.** Treatment systems shall be designed to reduce the maximum allowable discharge concentrations of the gas to one-half immediate dangerous to life and health (IDLH) at the point of discharge to the atmosphere. Where more than one gas is emitted to the treatment system, the treatment system shall be designed to handle the worst-case release based on the release rate, the quantity and the IDLH for all compressed gases stored or used.
- 35.4.2.2.7.3 Sizing.** Treatment systems shall be sized to process the maximum worst-case release of gas based on the maximum flow rate of release from the largest vessel utilized. The entire contents of the largest compressed gas vessel shall be considered.
- 35.4.2.2.7.4 Stationary tanks.** Stationary tanks shall be labeled with the maximum rate of release for the compressed gas contained based on valves or fittings that are inserted directly into the tank. Where multiple valves or fittings are provided, the maximum flow rate of release for valves or fittings with the highest flow rate shall be indicated. Where liquefied compressed gases are in contact with valves or fittings, the liquid flow rate shall be utilized for computation purposes. Flow rates indicated on the label shall be converted to m<sup>3</sup>/s of gas at normal temperature and pressure (NTP).
- 35.4.2.2.7.5 Portable tanks and cylinders.** The maximum flow rate of release for portable tanks and cylinders shall be calculated based on the total release from the cylinder or tank within the time specified in Table 35.4.2.2.7.5. When portable tanks or cylinders are equipped with approved excess flow or reduced flow valves, the worst-case release shall be determined by the maximum achievable flow from the valve as determined by the valve manufacturer or compressed gas supplier. Reduced flow and excess flow valves shall be permanently marked by the valve manufacturer to indicate the maximum design flow rate. Such markings shall indicate the flow rate for air under normal temperature and pressure.

**TABLE 35.4.2.2.7.5**  
**RATE OF RELEASE FOR CYLINDERS AND PORTABLE TANKS**

VESSEL TYPE	NONLIQUIFIED (minutes)	LIQUIFIED (minutes)
Containers	5	30
Portable tanks	40	240

- 35.4.2.2.8 Emergency power.** Emergency power in accordance with the SBC 401 shall be provided in lieu of standby power where any of the following systems are required:
1. Exhaust ventilation system,
  2. Treatment system,
  3. Gas detection system,
  4. Smoke detection system,
  5. Temperature control system,
  6. Fire alarm system,



7. Emergency alarm system.

**Exception:** Emergency power is not required for mechanical exhaust ventilation, treatment systems and temperature control systems where approved fail-safe engineered systems are installed.

**35.4.2.2.9 Automatic fire detection system—highly toxic compressed gases.** An approved automatic fire detection system shall be installed in rooms or areas where highly toxic compressed gases are stored or used. Activation of the detection system shall sound a local alarm. The fire detection system shall comply with Section 7.7.

**35.4.2.2.10 Gas detection system.** A gas detection system shall be provided to detect the presence of gas at or below the permissible exposure limit (PEL) or ceiling limit of the gas for which detection is provided. The system shall be capable of monitoring the discharge from the treatment system at or below one-half the IDLH limit.

**Exception:** A gas detection system is not required for toxic gases when the physiological warning properties for the gas are at a level below the accepted PEL for the gas.

**35.4.2.2.10.1 Alarms.** The gas detection system shall initiate a local alarm and transmit a signal to a constantly attended control station when a short-term hazard condition is detected. The alarm shall be both visual and audible and shall provide warning both inside and outside the area where gas is detected. The audible alarm shall be distinct from all other alarms.

**Exception:** Signal transmission to a constantly attended control station is not required where not more than one cylinder of highly toxic or toxic gas is stored.

**35.4.2.2.10.2 Shutoff of gas supply.** The gas-detection system shall automatically close the shutoff valve at the source on gas supply piping and tubing related to the system being monitored for whichever gas is detected.

**Exception:** Automatic shutdown is not required for reactors utilized for the production of highly toxic or toxic compressed gases where such reactors are:

1. Operated at pressures less than 103.4 kPa.
2. Constantly attended.
3. Provided with readily accessible emergency shutoff valves.

**35.4.2.2.10.3 Valve closure.** Automatic closure of shutoff valves shall be in accordance with the following:

1. When the gas-detection sampling point initiating the gas detection system alarm is within a gas cabinet or exhausted enclosure, the shutoff valve in the gas cabinet or exhausted enclosure for the specific gas detected shall automatically close.
2. Where the gas-detection sampling point initiating the gas detection system alarm is within a gas room and compressed gas containers are not in gas cabinets or exhausted enclosures, the shutoff valves on all gas lines for the specific gas detected shall automatically close.
3. Where the gas-detection sampling point initiating the gas detection system alarm is within a piping distribution manifold enclosure, the shutoff valve for the compressed container of specific gas detected supplying the manifold shall automatically close.

**Exception:** When the gas-detection sampling point initiating the gas-detection system alarm is at a use location or within a gas valve enclosure of a branch line downstream of a piping distribution manifold, the shutoff valve in the gas valve enclosure for the branch line located in the piping distribution manifold enclosure shall automatically close.

**35.4.3 Outdoor storage and use.** The outdoor storage and use of highly toxic and toxic compressed gases shall be in accordance with Sections 35.4.3.1 through 35.4.3.9.

- 35.4.3.1 Applicability.** The applicability of regulations governing the outdoor storage and use of highly toxic and toxic compressed gases shall be as set forth in Sections 35.4.3.1.1 through 35.4.3.1.3.
- 35.4.3.1.1 Quantities not exceeding the maximum allowable quantity per control area.** The outdoor storage or use of highly toxic and toxic gases in amounts not exceeding the maximum allowable quantity per control area set forth in Table 25.3.1.1(4) shall be in accordance with Sections 25.1, 25.3 and 35.1.
- 35.4.3.1.2 Quantities exceeding the maximum allowable quantity per control area.** The outdoor storage or use of highly toxic and toxic gases in amounts exceeding the maximum allowable quantity per control area set forth in Table 25.3.1.1(4) shall be in accordance with Sections 35.1 and 35.4.3 and Chapter 25.
- 35.4.3.1.3 Ozone gas generators.** The outdoor use of ozone gas-generating equipment shall be in accordance with Section 35.5.
- 35.4.3.2 General outdoor requirements.** The general requirements applicable to the outdoor storage and use of highly toxic and toxic compressed gases shall be in accordance with Sections 35.4.3.2.1 through 35.4.3.2.7.
- 35.4.3.2.1 Location.** Outdoor storage or use of highly toxic or toxic compressed gases shall be located in accordance with Sections 35.4.3.2.1.1 through 35.4.3.2.1.3.  
**Exception:** Compressed gases located in gas cabinets complying with Sections 25.3.8.5 and 35.4.1.2 and located 15.2 m or more from buildings and 7.6 m or more from an exit discharge.
- 35.4.3.2.1.1 Distance limitation to exposures.** Outdoor storage or use of highly toxic or toxic compressed gases shall not be located within 23 m of a lot line, public street, public alley, public way, exit discharge or building not associated with the manufacture or distribution of such gases, unless all of the following conditions are met:
1. Storage is shielded by a 2-hour fire barrier which interrupts the line of sight between the storage and the exposure.
  2. The 2-hour fire barrier shall be located at least 15.2 m from any exposure.
  3. The 2-hour fire barrier shall not have more than two sides at approximately 90-degree (1.57 rad) directions, or three sides with connecting angles of approximately 135 degrees (2.36 rad).
- 35.4.3.2.1.2 Openings in exposed buildings.** Where the storage or use area is located closer than 23 m to a building not associated with the manufacture or distribution of highly toxic or toxic compressed gases, openings into a building other than for piping are not allowed above the height of the top of the 2-hour fire barrier or within 15.2 m horizontally from the storage area whether or not shielded by a fire barrier.
- 35.4.3.2.1.3 Air intakes.** The storage or use area shall not be located within 23 m of air intakes.
- 35.4.3.2.2 Leaking cylinders and tanks.** The requirements of Section 35.4.2.2.3 shall apply to outdoor cylinders and tanks. Gas cabinets and exhausted enclosures shall be located within or immediately adjacent to outdoor storage or use areas.
- 35.4.3.2.3 Local exhaust for portable tanks.** Local exhaust for outdoor portable tanks shall be provided in accordance with the requirements set forth in Section 35.4.2.2.4.
- 35.4.3.2.4 Piping and controls—stationary tanks.** Piping and controls for outdoor stationary tanks shall be in accordance with the requirements set forth in Section 35.4.2.2.5.
- 35.4.3.2.5 Treatment systems.** The treatment system requirements set forth in Section 35.4.2.2.7 shall apply to highly toxic or toxic gases located outdoors.
- 35.4.3.2.6 Emergency power.** The requirements for emergency power set forth in Section 35.4.2.2.8 shall apply to highly toxic or toxic gases located outdoors.

- 35.4.3.2.7 Gas detection system.** The gas detection system requirements set forth in Section 35.4.2.2.10 shall apply to highly toxic or toxic gases located outdoors.
- 35.4.3.3 Outdoor storage weather protection for portable tanks and cylinders.** Weather protection in accordance with Section 25.4.13 shall be provided for portable tanks and cylinders located outdoors and not within gas cabinets or exhausted enclosures. The storage area shall be equipped with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1.
- Exception:** An automatic sprinkler system is not required when:
1. All materials under the weather protection structure, including hazardous materials and the containers in which they are stored, are noncombustible.
  2. The weather protection structure is located not less than 9.1 m from combustible materials or structures or is separated from such materials or structures using a fire barrier complying with Section 35.4.3.2.1.1.
- 35.4.3.4 Outdoor use of cylinders, containers and portable tanks.** Cylinders, containers and portable tanks in outdoor use shall be located in gas cabinets or exhausted enclosures.

## SECTION 35.5 OZONE GAS GENERATORS

- 35.5.1 Scope.** Ozone gas generators having a maximum ozone-generating capacity of 0.23 kg or more over a 24-hour period shall be in accordance with this section.
- Exception:** Ozone-generating equipment used in Group R-3 occupancies.
- 35.5.2 Design.** Ozone gas generators shall be designed, fabricated and tested in accordance with NEMA 250.
- 35.5.3 Location.** Ozone generators shall be located in approved cabinets or ozone generator rooms in accordance with Section 35.5.3.1 or 35.5.3.2.
- Exception:** An ozone gas generator within an approved pressure vessel when located outside of buildings.
- 35.5.3.1 Cabinets.** Ozone cabinets shall be constructed of approved materials and compatible with ozone. Cabinets shall display an approved sign stating: OZONE GAS GENERATOR – HIGHLY TOXIC – OXIDIZER.
- Cabinets shall be braced for seismic activity in accordance with the SBC 201 and 301.
- Cabinets shall be mechanically ventilated in accordance with the SBC 501 with a minimum of six air changes per hour.
- The average velocity of ventilation at makeup air openings with cabinet doors closed shall not be less than 1.02 m/s.
- 35.5.3.2 Ozone gas generator rooms.** Ozone gas generator rooms shall be mechanically ventilated in accordance with the SBC 501 with a minimum of six air changes per hour. Ozone gas generator rooms shall be equipped with a continuous gas detection system which will shutoff the generator and sound a local alarm when concentrations above the permissible exposure limit occur.
- Ozone gas-generator rooms shall not be normally occupied, and such rooms shall be kept free of combustible and hazardous material storage. Room access doors shall display an approved sign stating: OZONE GAS GENERATOR – HIGHLY TOXIC – OXIDIZER.
- 35.5.4 Piping, valves and fittings.** Piping, valves, fittings and related components used to convey ozone shall be in accordance with Sections 35.5.4.1 through 35.5.4.3.

- 35.5.4.1 Piping.** Piping shall be welded stainless steel piping or tubing.
- Exceptions:**
1. Double-walled piping.
  2. Piping, valves, fittings and related components located in exhausted enclosures.
- 35.5.4.2 Materials.** Materials shall be compatible with ozone and shall be rated for the design operating pressures.
- 35.5.4.3 Identification.** Piping shall be identified with the following: OZONE GAS – HIGHLY TOXIC – OXIDIZER.
- 35.5.5 Automatic shutdown.** Ozone gas generators shall be designed to shutdown automatically under the following conditions:
1. When the dissolved ozone concentration in the water being treated is above saturation when measured at the point where the water is exposed to the atmosphere.
  2. When the process using generated ozone is shutdown.
  3. When the gas detection system detects ozone.
  4. Failure of the ventilation system for the cabinet or ozone-generator room.
  5. Failure of the gas-detection system.
- 35.5.6 Manual shutdown.** Manual shutdown controls shall be provided at the generator and, where in a room, within 3.1 m of the main exit or exit access door.



## CHAPTER 36 LIQUEFIED PETROLEUM GASES

### SECTION 36.1 GENERAL

- 36.1.1 Scope.** Storage, handling and transportation of LP-gas and the installation of LP-gas equipment pertinent to systems for such uses shall comply with this chapter and NFPA 58. Properties of LP-gases shall be determined in accordance with Appendix B of NFPA 58.
- 36.1.2 Permits.** Permits shall be required as set forth in SBC 100. Distributors shall not fill an LP-gas container for which a permit is required unless a permit for installation has been issued for that location by the building code official.
- 36.1.3 Construction documents.** Where a single container is more than 7,570 L in water capacity or the aggregate capacity of containers is more than 15,140 L in water capacity, the installer shall submit construction documents for such installation.

### SECTION 36.2 DEFINITIONS

- 36.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.
- LIQUEFIED PETROLEUM GAS (LP-gas).** A material which is composed predominantly of the following hydrocarbons or mixtures of them: propane, propylene, butane (normal butane or iso-butane) and butylenes.

### SECTION 36.3 INSTALLATION OF EQUIPMENT

- 36.3.1 General.** Liquefied petroleum gas equipment shall be installed in accordance with the NFPA 58, except as otherwise provided in this chapter.
- 36.3.2 Use of LP-gas containers in buildings.** The use of LP-gas containers in buildings shall be in accordance with Sections 36.3.2.1 and 36.3.2.2.
- 36.3.2.1 Portable containers.** Portable LP-gas containers, as defined in NFPA 58, shall not be used in buildings except as specified in NFPA 58 and Sections 36.3.2.1.1 through 36.3.2.1.7.
- 36.3.2.1.1 Use in basement, pit or similar location.** LP-gas containers shall not be used in a basement, pit or similar location where heavier-than-air gas might collect. LP-gas containers shall not be used in an above-grade under floor space or basement unless such location is provided with an approved means of ventilation.  
**Exception:** Use with self-contained torch assemblies in accordance with Section 36.3.2.1.6.
- 36.3.2.1.2 Construction and temporary heating.** Portable containers are allowed to be used in buildings or areas of buildings undergoing construction or for temporary heating as set forth in Sections 3.4.3, 3.4.4, and 3.4.7 of NFPA 58.
- 36.3.2.1.3 Group F occupancies.** In Group F occupancies, portable LP-gas containers are allowed to be used to supply quantities necessary for processing, research or

experimentation. Where manifolded, the aggregate water capacity of such containers shall not exceed 334 kg per manifold. Where multiple manifolds of such containers are present in the same room, each manifold shall be separated from other manifolds by a distance of not less than 6.1 m.

- 36.3.2.1.4 Group E and I occupancies.** In Group E and I occupancies, portable LP-gas containers are allowed to be used for research and experimentation. Such containers shall not be used in classrooms. Such containers shall not exceed a 23 kg water capacity in occupancies used for educational purposes and shall not exceed a 5 kg water capacity in occupancies used for institutional purposes. Where more than one such container is present in the same room, each container shall be separated from other containers by a distance of not less than 6.1 m.
- 36.3.2.1.5 Demonstration uses.** Portable LP-gas containers are allowed to be used temporarily for demonstrations and public exhibitions. Such containers shall not exceed a water capacity of 5 kg. Where more than one such container is present in the same room, each container shall be separated from other containers by a distance of not less than 6.1 m.
- 36.3.2.1.6 Use with self-contained torch assemblies.** Portable LP-gas containers are allowed to be used to supply approved self-contained torch assemblies or similar appliances. Such containers shall not exceed a water capacity of 1 kg.
- 36.3.2.1.7 Use for food preparation.** Where approved, listed LP-gas commercial food service appliances are allowed to be used for food-preparation within restaurants and in attended commercial food-catering operations in accordance with the SBC 501 and NFPA 58.
- 36.3.2.2 Industrial vehicles and floor maintenance machines.** Containers on industrial vehicles and floor maintenance machines shall comply with NFPA 58, Section 8.3 and 8.4.
- 36.3.3 Location of equipment and piping.** Equipment and piping shall not be installed in locations where such equipment and piping is prohibited by the SBC.

## SECTION 36.4 LOCATION OF CONTAINERS

- 36.4.1 General.** The storage and handling of LP-gas and the installation and maintenance of related equipment shall comply with NFPA 58 and be subject to the approval of the building code official, except as provided in this chapter.
- 36.4.2 Maximum capacity within established limits.** Within the limits established by law restricting the storage of liquefied petroleum gas for the protection of heavily populated or congested areas, the aggregate capacity of any one installation shall not exceed a water capacity of 7,570 L.  
**Exception:** In particular installations, this capacity limit shall be determined by the building code official, after consideration of special features such as topographical conditions, nature of occupancy, and proximity to buildings, capacity of proposed containers, degree of fire protection to be provided and capabilities of the local Civil Defence.
- 36.4.3 Container location.** Containers shall be located with respect to buildings, public ways, and lot lines of adjoining property that can be built upon, in accordance with Table 36.4.3.

**TABLE 36.4.3**  
**LOCATION OF LP-GAS CONTAINERS**

CONTAINER CAPACITY (water liters)	MINIMUM SEPARATION BETWEEN CONTAINERS AND BUILDINGS, PUBLIC WAYS OR LOT LINES OF ADJOINING PROPERTY THAT CAN BE BUILT UPON		MINIMUM SEPARATION BETWEEN CONTAINERS <sup>b,c</sup> (meter)
	Mounded or underground containers <sup>a</sup> (meter)	Above-ground containers <sup>b</sup> (meter)	
Less than 473 <sup>c,d</sup>	3.1	1.5 <sup>e</sup>	None
473 to 946	3.1	3.1	None
947 to 1,893	3.1	3.1	0.9
1,894 to 7,570	3.1	7.6 <sup>e,f</sup>	0.9
7,571 to 113,550	15.3	15.3	1.5
113,551 to 264,950	15.3	23	(0.25 of sum of diameters of adjacent containers)
264,951 to 340,650	15.3	30.5	
340,651 to 454,200	15.3	38	

- a. Minimum distance for underground containers shall be measured from the pressure relief device and the filling or liquid-level gauge vent connection at the container, except that all parts of an underground container shall be 3.1 m or more from a building or lot line of adjoining property which can be built upon.
- b. For other than installations in which the overhanging structure is 15.3 m or more above the relief-valve discharge outlet. In applying the distance between buildings and containers with a water capacity of 473 liters or more, a minimum of 50 percent of this horizontal distance shall also apply to all portions of the building which project more than 1.5 m from the building wall and which are higher than the relief valve discharge outlet. This horizontal distance shall be measured from a point determined by projecting the outside edge of such overhanging structure vertically downward to grade or other level upon which the container is installed. Distances to the building wall shall not be less than those prescribed in this table.
- c. When underground multicontainer installations are comprised of individual containers having a water capacity of 473 liters or more, such containers shall be installed so as to provide access at their ends or sides to facilitate working with cranes or hoists.
- d. At a consumer site, if the aggregate water capacity of a multicontainer installation, comprised of individual containers having a water capacity of less than 473 liters, is 1,893 liters or more, the minimum distance shall comply with the appropriate portion of Table 36.4.3, applying the aggregate capacity rather than the capacity per container. If more than one such installation is made, each installation shall be separated from other installations by at least 7.6 m. Minimum distances between containers need not be applied.
- e. The following shall apply to above-ground containers installed alongside buildings:
1. Containers of less than a 473 liters water capacity are allowed next to the building they serve when in compliance with Items 2, 3 and 4.
  2. Specification containers shall be located and installed so that the discharge from the container pressure relief device is at least 0.9 m horizontally from building openings below the level of such discharge and shall not be beneath buildings unless the space is well ventilated to the outside and is not enclosed for more than 50 percent of its perimeter. The discharge from container pressure relief devices shall be located not less than 1.5 m from exterior sources of ignition, openings into direct-vent (sealed combustion system) appliances or mechanical ventilation air intakes.
  3. Containers of less than a 473 liters water capacity shall be located and installed such that the discharge from pressure relief devices shall not terminate in or beneath buildings and shall be located at least 1.5 m horizontally from building openings below the level of such discharge and not less than 1.5 m from exterior sources of ignition, openings into direct vent (sealed combustion system) appliances, or mechanical ventilation air intakes.
  4. The filling connection and the vent from liquid-level gauges on ASME containers filled at the point of installation shall not be less than 3.1 m from exterior sources of ignition, openings into direct vent (sealed combustion system) appliances or mechanical ventilation air intakes.
- f. This distance is allowed to be reduced to not less than 3.1 m for a single container of 4,542 liters water capacity or less, provided such container is at least 7.6 m from other LP-gas containers of more than 473 liters water capacity.

**36.4.3.1 Special hazards.** Containers shall also be located with respect to special hazards such as above-ground flammable or combustible liquid tanks, oxygen or gaseous hydrogen containers, flooding or electric power lines as specified in NFPA 58, Section 3.2.2.6.



- 36.4.4 Multiple container installation.** Multiple container installations with a total water storage capacity of more than 681,300 L shall be subdivided into groups containing not more than 681,300 L in each group. Such groups shall be separated by a distance of not less than 15.3 m, unless the containers are protected in accordance with one of the following:
1. Mounded in an approved manner.
  2. Protected with approved insulation on areas that are subject to impingement of ignited gas from pipelines or other leakage.
  3. Protected by firewalls of approved construction.
  4. Protected by an approved system for application of water as specified in NFPA 58, Table 3.2.2.4.
  5. Protected by other approved means.
- Where one of these forms of protection is provided, the separation shall not be less than 7.6 m between container groups.

## SECTION 36.5 PROHIBITED USE OF LP-GAS

- 36.5.1 Non-approved equipment.** Liquefied petroleum gas shall not be used for the purpose of operating devices or equipment unless such device or equipment is approved for use with LP-gas.
- 36.5.2 Release to the atmosphere.** Liquefied petroleum gas shall not be released to the atmosphere, except through an approved liquid-level gauge or other approved device.

## SECTION 36.6 DISPENSING AND OVERFILLING

- 36.6.1 Attendants.** Dispensing of LP-gas shall be performed by a qualified attendant.
- 36.6.2 Overfilling.** Liquefied petroleum gas containers shall not be filled or maintained with LP-gas in excess of either the volume determined using the fixed liquid-level gauge installed by the manufacturer, or the weight determined by the required percentage of the water capacity marked on the container.
- 36.6.3 Dispensing locations.** The point of transfer of LP-gas from one container to another shall be separated from exposures as specified in NFPA 58.

## SECTION 36.7 SAFETY PRECAUTIONS AND DEVICES

- 36.7.1 Safety devices.** Safety devices on LP-gas containers, equipment and systems shall not be tampered with or made ineffective.
- 36.7.2 Smoking and other sources of ignition.** “No Smoking” signs complying with Section 5A.10 shall be posted when required by the building code official. Smoking within 7.6 m of a point of transfer, while filling operations are in progress at containers or vehicles, shall be prohibited. Control of other sources of ignition shall comply with Chapter 5 and NFPA 58, Section 3.7.

**36.7.3 Clearance to combustibles.** Weeds, grass, brush, trash and other combustible materials shall be kept a minimum of 3.1 m from LP-gas tanks or containers.

**36.7.4 Protecting containers from vehicles.** Where exposed to vehicular damage due to proximity to alleys, driveways or parking areas, LP-gas containers, regulators and piping shall be protected in accordance with Section 5A.12.

## **SECTION 36.8 FIRE PROTECTION**

**36.8.1 General.** Fire protection shall be provided for installations having storage containers with a water capacity of more than 15,140 L, as required by NFPA 58.

**36.8.2 Fire extinguishers.** Fire extinguishers complying with Section 7.6 shall be provided as specified in NFPA 58.

## **SECTION 36.9 STORAGE OF PORTABLE LP-GAS CONTAINERS AWAITING USE OR RESALE**

**36.9.1 General.** Storage of portable containers of 454 kg or less, whether filled, partially filled or empty, at consumer sites or distributing points, and for resale by dealers or resellers shall comply with Sections 36.9.2 through 36.9.15.

**Exceptions:**

1. Containers that have not previously been in LP-gas service.
2. Containers at distributing plants.
3. Containers at consumer sites or distributing points, which are connected for use.

**36.9.2 Exposure hazards.** Containers in storage shall be located in a manner which minimizes exposure to excessive temperature rise, physical damage or tampering.

**36.9.3 Position.** Containers in storage having individual water capacity greater than 1 kg shall be positioned with the pressure relief valve in direct communication with the vapor space of the container.

**36.9.4 Separation from means of egress.** Containers stored in buildings in accordance with Sections 36.9.9 and 36.9.11 shall not be located near exit access doors, exits, stairways, or in areas normally used, or intended to be used, as a means of egress.

**36.9.5 Quantity.** Empty containers that have been in LP-gas service shall be considered as full containers for the purpose of determining the maximum quantities of LP-gas allowed in Sections 36.9.9 and 36.9.11.

**36.9.6 Storage on roofs.** Containers which are not connected for use shall not be stored on roofs.

**36.9.7 Storage in basement, pit or similar location.** Liquefied petroleum gas containers shall not be stored in a basement, pit or similar location where heavier-than-air gas might collect. Liquefied petroleum gas containers shall not be stored in above-grade under floor spaces or basements unless such location is provided with an approved means of ventilation.

**Exception:** Cylinders with a maximum water capacity of 1 kg for use in completely self-contained hand torches and similar applications. The quantity of LP-gas shall not exceed 9 kg.

- 36.9.8 Protection of valves on containers in storage.** Container valves shall be protected by screw-on-type caps or collars which shall be securely in place on all containers stored regardless of whether they are full, partially full or empty. Container outlet valves shall be closed or plugged.
- 36.9.9 Storage within buildings accessible to the public.** Specification cylinders with maximum water capacity of 1 kg used in completely self-contained hand torches and similar applications are allowed to be stored or displayed in a building accessible to the public. The quantity of LP-gas shall not exceed 91 kg except as provided in Section 36.9.11.
- 36.9.10 Storage within buildings not accessible to the public.** The maximum quantity allowed in one storage location in buildings not accessible to the public, such as industrial buildings, shall not exceed a water capacity of 334 kg [nominal 136 kg of LP-gas]. Where additional storage locations are required on the same floor within the same building, they shall be separated by a minimum of 91.5 m. Storage beyond these limitations shall comply with Section 36.9.11.
- 36.9.10.1 Quantities on equipment and vehicles.** Containers carried as part of service equipment on highway mobile vehicles need not be considered in the total storage capacity in Section 36.9.10, provided such vehicles are stored in private garages and do not carry more than three LP-gas containers with a total aggregate LP-gas capacity not exceeding 45.4 kg per vehicle. Container valves shall be closed.
- 36.9.11 Storage within rooms used for gas manufacturing.** Storage within buildings or rooms used for gas manufacturing, gas storage, gas-air mixing and vaporization, and compressors not associated with liquid transfer shall comply with Sections 36.9.11.1 and 36.9.11.2.
- 36.9.11.1 Quantity limits.** The maximum quantity of LP-gas shall be 4,540 kg.
- 36.9.11.2 Construction.** The construction of such buildings and rooms shall comply with requirements for Group H occupancies in the SBC 201; NFPA 58, Chapter 4 and both of the following:
1. Adequate vents shall be provided to the outside at both top and bottom, located at least 1.5 m from building openings.
  2. The entire area shall be classified for the purposes of ignition source control in accordance with NFPA 58, Section 3.7.
- 36.9.12 Location of storage outside of buildings.** Storage outside of buildings, for containers awaiting use, resale or part of a cylinder exchange program shall be located not less than 6.1 m from openings into buildings, 6.1 m from any motor vehicle fuel dispenser and 3.1 m from any combustible material and in accordance with Table 36.9.12.

**TABLE 36.9.12**  
**LOCATION OF CONTAINERS AWAITING USE OR RESALE STORED OUTSIDE**  
**OF BUILDINGS**

<b>QUANTITY OF LP-GAS STORED (kilograms)</b>	<b>DISTANCES TO A BUILDING OR GROUP OF BUILDINGS, PUBLIC WAY OR LOT LINE OF PROPERTY THAT CAN BE BUILT UPON (meter)</b>
227 or less	0
228 to 1,135	3.1 <sup>a</sup>
1,136 to 2,724	4.6
2,725 to 4,540	6.1
Over 4,540	7.6

a. Containers are allowed to be located a lesser distance.

- 36.9.13 Protection of containers.** Containers shall be stored within a suitable enclosure or otherwise protected against tampering. Vehicular protection shall be provided as required by the building code official.
- 36.9.14 Separation from means of egress for containers located outside of buildings.** Containers located outside of buildings shall not be located within 6.1 m of any exit access doors, exits, stairways or in areas normally used, or intended to be used, as a means of egress.
- 36.9.15 Alternative location and protection of storage.** Where the provisions of Sections 36.9.12 and 36.9.13 are impractical at construction sites or at buildings or structures undergoing major renovation or repairs, the storage of containers shall be as required by the building code official.

### **SECTION 36.10** **CONTAINERS NOT IN SERVICE**

- 36.10.1 Temporarily out of service.** Containers whose use has been temporarily discontinued shall comply with all of the following:
1. Be disconnected from appliance piping.
  2. Have container outlets, except relief valves, closed or plugged.
  3. Be positioned with the relief valve in direct communication with container vapor space.
- 36.10.2 Permanently out of service.** Containers to be placed permanently out of service shall be removed from the site.

### **SECTION 36.11** **PARKING AND GARAGING**

- 36.11.1 General.** Parking of LP-gas tank vehicles shall comply with Sections 36.11.2 and 36.11.3.
- Exception:** In cases of accident, breakdown or other emergencies, tank vehicles are allowed to be parked and left unattended at any location while the operator is obtaining assistance.
- 36.11.2 Unattended parking.** The unattended parking of LP-gas tank vehicle shall be in

accordance with Sections 36.11.2.1 and 36.11.2.2.

- 36.11.2.1 Near residential, educational and institutional occupancies and other high-risk areas.** Liquefied petroleum gas tank vehicles shall not be left unattended at any time on residential streets or within 152 m of a residential area, apartment or hotel complex, educational facility, hospital or care facility. Tank vehicles shall not be left unattended at any other place that would, in the opinion of the building code official, pose an extreme life hazard.
- 36.11.2.2 Durations exceeding 1 hour.** Liquefied petroleum gas tank vehicles parked at any one point for longer than 1 hour shall be located as follows:
- 1.** Off public streets, highways, public avenues or public alleys.
  - 2.** Inside of a bulk plant.
  - 3.** At other approved locations not less than 15.3 m from buildings other than those approved for the storage or servicing of such vehicles.
- 36.11.3 Garaging.** Garaging of LP-gas tank vehicles shall be as specified in NFPA 58. Vehicles with LP-gas fuel systems are allowed to be stored or serviced in garages as specified in NFPA 58, Section 8.6.

## CHAPTER 37 ORGANIC PEROXIDES

### SECTION 37.1 GENERAL

- 37.1.1 Scope.** The storage and use of organic peroxides shall be in accordance with this chapter and Chapter 25.  
Unclassified detonable organic peroxides that are capable of detonation in their normal shipping containers under conditions of fire exposure shall be stored in accordance with Chapter 31.
- 37.1.2 Permits.** Permits shall be required for organic peroxides as set forth in SBC 100.

### SECTION 37.2 DEFINITIONS

- 37.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**ORGANIC PEROXIDE.** An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radical. Organic peroxides can present an explosion hazard (detonation or deflagration) or they can be shock sensitive. They can also decompose into various unstable compounds over an extended period of time.

**Class I.** Describes those formulations that are capable of deflagration but not detonation.

**Class II.** Describes those formulations that burn very rapidly and that pose a moderate reactivity hazard.

**Class III.** Describes those formulations that burn rapidly and that pose a moderate reactivity hazard.

**Class IV.** Describes those formulations that burn in the same manner as ordinary combustibles and that pose a minimal reactivity hazard.

**Class V.** Describes those formulations that burn with less intensity than ordinary combustibles or do not sustain combustion and that pose no reactivity hazard.

**Unclassified detonable.** Organic peroxides that are capable of detonation. These peroxides pose an extremely high-explosion hazard through rapid explosive decomposition.

### SECTION 37.3 GENERAL REQUIREMENTS

- 37.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of organic peroxides in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3, 37.1 and 37.3.
- 37.3.1.1 Special limitations for indoor storage and use by occupancy.** The indoor storage and use of organic peroxides shall be in accordance with Sections 37.3.1.1.1 through 37.3.1.1.4.

- 37.3.1.1.1 Group A, E, I or U occupancies.** In Group A, E, I or U occupancies, any amount of unclassified detonable and Class I organic peroxides shall be stored in accordance with the following:
1. Unclassified detonable and Class I organic peroxides shall be stored in hazardous materials storage cabinets complying with Section 25.3.8.7.
  2. The hazardous materials storage cabinets shall not contain other storage.
- 37.3.1.1.2 Group R occupancies.** Unclassified detonable and Class I organic peroxides shall not be stored or used within Group R occupancies.
- 37.3.1.1.3 Group B, F, M or S occupancies.** Unclassified detonable and Class I organic peroxides shall not be stored or used in offices, or retail sales areas of Group B, F, M or S occupancies.
- 37.3.1.1.4 Classrooms.** In classrooms in Group B, F or M occupancies, any amount of unclassified detonable and Class 1 organic peroxides shall be stored in accordance with the following:
1. Unclassified detonable and Class 1 organic peroxides shall be stored in hazardous materials storage cabinets complying with Section 25.3.8.7.
  2. The hazardous materials storage cabinets shall not contain other storage.
- 37.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of organic peroxides in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

## SECTION 37.4 STORAGE

- 37.4.1 Indoor storage.** Indoor storage of organic peroxides in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.  
Indoor storage of unclassified detonable organic peroxides that are capable of detonation in their normal shipping containers under conditions of fire exposure shall be stored in accordance with Chapter 31.
- 37.4.1.1 Detached storage.** Storage of organic peroxides shall be in detached buildings when required by Section 25.3.8.2.
- 37.4.1.2 Distance from detached storage buildings to exposures.** In addition to the requirements of the SBC 201, detached storage buildings shall be located in accordance with Table 37.4.1.2.

**TABLE 37.4.1.2**  
**ORGANIC PEROXIDES—DISTANCE TO EXPOSURES FROM DETACHED STORAGE**  
**BUILDINGS OR OUTDOOR STORAGE AREAS**

ORGANIC PEROXIDE CLASS	MAXIMUM STORAGE QUANTITY (KILOGRAMS) AT MINIMUM SEPARATION DISTANCE					
	Distance to buildings, lot lines, public streets, public alleys, public ways or means of egress			Distance between individual detached storage buildings or individual outdoor storage areas		
	15.3 meters	30.5 meters	46 meters	6.1 meters	23 meters	30.5 meters
I	908	9,080	79,450	908	9,080	79,450
II	45,400	90,800	No Limit	45,400 <sup>a</sup>	No Limit	No Limit
III	90,800	No Limit	No Limit	90,800 <sup>a</sup>	No Limit	No Limit
IV	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
V	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit

a. When the amount of organic peroxide stored exceeds this amount, the minimum separation shall be 15.3 m.

- 37.4.1.3 Liquid-tight floor.** In addition to the requirements of Section 25.4.12, floors of storage areas shall be of liquid-tight construction.
- 37.4.1.4 Electrical wiring and equipment.** In addition to the requirements of Section 25.3.9.4, electrical wiring and equipment in storage areas for Class I or II organic peroxides shall comply with the requirements for electrical Class I, Division 2 locations.
- 37.4.1.5 Smoke detection.** An approved supervised smoke detection system in accordance with Section 7.7 shall be provided in rooms or areas where Class I, II or III organic peroxides are stored. Activation of the smoke detection system shall sound a local alarm.  
**Exception:** A smoke detection system shall not be required in detached storage buildings equipped throughout with an approved automatic fire-extinguishing system complying with Chapter 7.
- 37.4.1.6 Maximum quantities.** Maximum allowable quantities per building in a mixed occupancy building shall not exceed the amounts set forth in Table 25.3.8.2. Maximum allowable quantities per building in a detached storage building shall not exceed the amounts specified in Table 37.4.1.2.
- 37.4.1.7 Storage arrangement.** Storage arrangements for organic peroxides shall be in accordance with Table 37.4.2.4 and shall comply with all of the following:
1. Containers and packages in storage areas shall be closed.
  2. Bulk storage shall not be in piles or bins.
  3. A minimum 0.6 m clear space shall be maintained between storage and uninsulated metal walls.
  4. Two hundreds and eight liters drums shall not be stored more than one drum high.
- 37.4.1.8 Location in building.** The storage of Class I or II organic peroxides shall be on the ground floor. Class III organic peroxides shall not be stored in basements.
- 37.4.1.9 Contamination.** Organic peroxides shall be stored in their original shipping containers. Organic peroxides shall be stored in a manner to prevent contamination.
- 37.4.1.10 Explosion control.** Indoor storage rooms, areas and buildings containing unclassified detonable and Class I organic peroxides shall be provided with explosion control in accordance with Section 7.11.
- 37.4.1.11 Standby power.** Standby power in accordance with Section 4.4 shall be provided for storage areas of Class I and unclassified detonable organic 25.3.1.1(3).
- 37.4.2 Outdoor storage.** Outdoor storage of organic peroxides in amounts exceeding the maximum allowable quantities per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.
- 37.4.2.1 Distance from storage to exposures.** Outdoor storage areas for organic peroxides shall be located in accordance with Table 37.4.1.2.
- 37.4.2.2 Electrical wiring and equipment.** In addition to the requirements of Section 25.3.9.4, electrical wiring and equipment in outdoor storage areas containing unclassified detonable, Class I or II organic peroxides shall comply with the requirements for electrical Class I, Division 2 locations.
- 37.4.2.3 Maximum quantities.** Maximum quantities of organic peroxides in outdoor storage shall be in accordance with Table 37.4.1.2.
- 37.4.2.4 Storage arrangement.** Storage arrangements shall be in accordance with Table 37.4.2.4.
- 37.4.2.5 Separation.** In addition to the requirements of Section 25.3.9.8, outdoor storage areas for organic peroxides in amounts exceeding those specified in Table 25.3.8.2



shall be located a minimum distance of 15.3 m from other hazardous material storage.

## SECTION 37.5 USE

**37.5.1 General.** The use of organic peroxides in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter.

**TABLE 37.4.2.4  
STORAGE OF ORGANIC PEROXIDES**

ORGANIC PEROXIDE CLASS	PILE CONFIGURATION				MAXIMUM QUANTITY PER BUILDING
	Maximum width (meters)	Maximum height (meters)	Minimum distance to next pile (meters)	Minimum distance to walls (meters)	
I	1.8	2.4	1.2 <sup>a</sup>	1.2 <sup>b</sup>	Note c
II	3.1	2.4	1.2 <sup>a</sup>	1.2 <sup>b</sup>	Note c
III	3.1	2.4	1.2 <sup>a</sup>	1.2 <sup>b</sup>	Note c
IV	4.8	3.1	0.9 <sup>a,d</sup>	1.2 <sup>b</sup>	No Requirement
V	No Requirement	No Requirement	No Requirement	No Requirement	No Requirement

- a. At least one main aisle with a minimum width of 2.4 m shall divide the storage area.
- b. Distance to noncombustible walls is allowed to be reduced to 0.6 m.
- c. See Table 37.4.1.2 for maximum quantities.
- d. The distance shall not be less than one-half the pile height.

## CHAPTER 38 OXIDIZERS

### SECTION 38.1 GENERAL

- 38.1.1 Scope.** The storage and use of oxidizers shall be in accordance with this chapter and Chapter 25. Compressed gases shall also comply with Chapter 28.  
**Exception:** Display and storage in Group M and storage in Group S occupancies complying with Section 25.3.11. Bulk oxygen systems at industrial and institutional consumer sites shall be in accordance with NFPA 50.
- 38.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 38.2 DEFINITIONS

- 38.2.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meanings shown herein.

**BULK OXYGEN SYSTEM.** An assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds and interconnecting piping, that has a storage capacity of more than 566 m<sup>3</sup> of oxygen at normal temperature and pressure (NTP) including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers can be stationary or movable, and the oxygen can be stored as a gas or liquid.

**OXIDIZER.** A material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials. Examples of other oxidizing gases include bromine, chlorine and fluorine.

**Class 4.** An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock. In addition, the oxidizer will enhance the burning rate and can cause spontaneous ignition of combustibles.

**Class 3.** An oxidizer that will cause a severe increase in the burning rate of combustible materials with which it comes in contact or that will undergo vigorous self-sustained decomposition caused by contamination or exposure to heat.

**Class 2.** An oxidizer that will cause a moderate increase in the burning rate or that causes spontaneous ignition of combustible materials with which it comes in contact.

**Class 1.** An oxidizer whose primary hazard is that it slightly increases the burning rate but which does not cause spontaneous ignition when it comes in contact with combustible materials.

**OXIDIZING GAS.** A gas that can support and accelerate combustion of other materials.

## SECTION 38.3 GENERAL REQUIREMENTS

- 38.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of oxidizers in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3, 38.1 and 38.3. Oxidizing gases shall also comply with Chapter 28.
- 38.3.1.1 Special limitations for indoor storage and use by occupancy.** The indoor storage and use of oxidizers shall be in accordance with Sections 38.3.1.1.1 through 38.1.1.3.
- 38.3.1.1.1 Class 4 liquid and solid oxidizers.** The storage and use of Class 4 liquid and solid oxidizers shall comply with Sections 38.3.1.1.1.1 through 38.3.1.1.1.4.
- 38.3.1.1.1.1 Group A, E, I or U occupancies.** In Group A, E, I or U occupancies, any amount of Class 4 liquid and solid oxidizers shall be stored in accordance with the following:
1. Class 4 liquid and solid oxidizers shall be stored in hazardous materials storage cabinets complying with Section 25.3.8.7.
  2. The hazardous materials storage cabinets shall not contain other storage.
- 38.3.1.1.1.2 Group R occupancies.** Class 4 liquid and solid oxidizers shall not be stored or used within Group R occupancies.
- 38.3.1.1.1.3 Offices, and retail sales areas.** Class 4 liquid and solid oxidizers shall not be stored or used in offices, or retail sales areas of Group B, F, M or S occupancies.
- 38.3.1.1.1.4 Classrooms.** In classrooms of Group B, F or M occupancies, any amount of Class 4 liquid and solid oxidizers shall be stored in accordance with the following:
1. Class 4 liquid and solid oxidizers shall be stored in hazardous materials storage cabinets complying with Section 25.3.8.7.
  2. Hazardous materials storage cabinets shall not contain other storage.
- 38.3.1.1.2 Class 3 liquid and solid oxidizers.** A maximum of 91 kg of solid or 76 L of liquid Class 3 oxidizer is allowed in Group I occupancies when such materials are necessary for maintenance purposes or operation of equipment. The oxidizers shall be stored in approved containers and in an approved manner.
- 38.3.1.1.3 Oxidizing gases.** Except for cylinders not exceeding a capacity of 7 m<sup>3</sup> each used for maintenance purposes, patient care or operation of equipment, oxidizing gases shall not be stored or used in Group A, B, E, I, or R occupancies. The aggregate quantities of gases used for maintenance purposes and operation of equipment shall not exceed the maximum allowable quantity per control area listed in Table 25.3.1.1(1). Medical gas systems and medical gas supply cylinders shall also be in accordance with Section 28.6.
- 38.3.1.2 Emergency shutoff.** Compressed gas systems conveying oxidizer gases shall be provided with approved emergency shutoff valves that can be activated at each point of use and each source.
- 38.3.1.3 Ignition source control.** Ignition sources in areas containing oxidizing gases shall be controlled in accordance with Section 25.3.7.
- 38.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of oxidizers in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

## SECTION 38.4 STORAGE

- 38.4.1 Indoor storage.** Indoor storage of oxidizers in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.
- 38.4.1.1 Detached storage.** Storage of liquid and solid oxidizers shall be in detached buildings when required by Section 25.3.8.2.
- 38.4.1.2 Distance from detached storage buildings to exposures.** In addition to the requirements of the SBC 100 and 201, detached storage buildings shall be located in accordance with Table 38.4.1.2.

**TABLE 38.4.1.2  
OXIDIZER LIQUIDS AND SOLIDS — DISTANCE FROM DETACHED  
BUILDINGS AND OUTDOOR STORAGE AREAS TO EXPOSURES**

OXIDIZER CLASS	WEIGHT (kg)	MINIMUM DISTANCE TO BUILDINGS, LOT LINES, PUBLIC STREETS, PUBLIC ALLEYS, PUBLIC WAYS OR MEANS OF EGRESS (m)
1	Note a	Not Required
2	Note a	10.7
3	Note a	15.2
4	over 4.5 to 45.4	22.9
	45.9 to 227	30.5
	227.5 to 454	38.1
	454.5 to 1,362	61
	1,362.5 to 2,270	91.4
	2,270.5 to 4,540	122
	over 4,540	As required by the code official

- a. Any quantity over the amount required for detached storage in accordance with Section 25.3.8.2, or over the outdoor maximum allowable quantity for outdoor control areas.

- 38.4.1.3 Explosion control.** Indoor storage rooms, areas and buildings containing Class 4 liquid or solid oxidizers shall be provided with explosion control in accordance with Section 7.11.
- 38.4.1.4 Automatic sprinkler system.** The automatic sprinkler system shall be designed in accordance with NFPA 430.
- 38.4.1.5 Liquid-tight floor.** In addition to Section 25.4.12, floors of storage areas for liquid and solid oxidizers shall be of liquid-tight construction.
- 38.4.1.6 Smoke detection.** An approved supervised smoke detection system in accordance with Section 7.7 shall be installed in liquid and solid oxidizer storage areas. Activation of the smoke detection system shall sound a local alarm.  
**Exception:** Detached storage buildings protected by an approved automatic fire-extinguishing system.
- 38.4.1.7 Storage conditions.** The maximum quantity of oxidizers per building in detached storage buildings shall not exceed those quantities set forth in Tables 38.4.1.7(1) through 38.4.1.7(4).

The storage configuration for liquid and solid oxidizers shall be as set forth in Tables 38.4.1.7(1) through 38.4.1.7(4).

Class 2 oxidizers shall not be stored in basements except when such storage is in stationary tanks.

Class 3 and 4 oxidizers in amounts exceeding the maximum allowable quantity per control area set forth in Section 25.3.1 shall be stored on the ground floor only.

**TABLE 38.4.1.7(1)**  
**STORAGE OF CLASS 1 OXIDIZER LIQUIDS AND SOLIDS IN**  
**COMBUSTIBLE CONTAINERS<sup>a</sup>**

STORAGE CONFIGURATION	LIMITS (m)
Piles	
Maximum length	No Limit
Maximum width	15.2
Maximum height	6.1
Minimum distance to next pile	0.9
Minimum distance to walls	0.6
Maximum quantity per pile	No Limit
Maximum quantity per building	No Limit

a. Storage in noncombustible containers or in bulk in detached storage buildings is not limited as to quantity or arrangement.

**TABLE 38.4.1.7(2)**  
**STORAGE OF CLASS 2 OXIDIZER LIQUIDS AND SOLIDS<sup>a, b</sup>**

STORAGE CONFIGURATION	LIMITS		
	Segregated storage	Cutoff storage rooms <sup>c</sup>	Detached building
Piles			
Maximum width	4.9 m	7.6 m	7.6 m
Maximum height	3 m	3.7 m	3.7 m
Minimum distance to next pile	Note d	Note d	Note d
Minimum distance to walls	0.6 m	0.6 m	0.6 m
Maximum quantity per pile	18.1 metric tons	45.4 metric tons	181.4 metric tons
Maximum quantity per building	181.4 metric tons	453.6 metric tons	No Limit

- a. Storage in noncombustible containers is not limited as to quantity or arrangement, except that piles shall be at least 0.61 m from walls in sprinklered buildings and 1.2 m from walls in nonsprinklered buildings; the distance between piles shall not be less than the pile height.
- b. Quantity limits shall be reduced by 50 percent in buildings or portions of buildings used for retail sales.
- c. Cutoff storage rooms shall be separated from the remainder of the building by 2 hours fire barriers.
- d. Aisle width shall not be less than the pile height.

**TABLE 38.4.1.7(3)**  
**STORAGE OF CLASS 3 OXIDIZER LIQUIDS AND SOLIDS<sup>a,b</sup>**

STORAGE CONFIGURATION	LIMITS		
	Segregated storage	Cutoff storage rooms <sup>c</sup>	Detached building
Piles			
Maximum width	3.7 m	4.9 m	6.1 m
Maximum height	2.4 m	3 m	3 m
Minimum distance to next pile	Note d	Note d	Note d
Minimum distance to walls	1.2 m	1.2 m	1.2 m
Maximum quantity per pile	18.1 metric tons	27.2 metric tons	136.1 metric tons
Maximum quantity per building	90.7 metric tons	453.6 metric tons	No Limit

- a. Storage in noncombustible containers is not limited as to quantity or arrangement, except that piles shall be at least 0.61 m from walls in sprinklered buildings and 1.2 m from walls in nonsprinklered buildings; the distance between piles shall not be less than the pile height.
- b. Quantity limits shall be reduced by 50 percent in buildings or portions of buildings used for retail sales.
- c. Cutoff storage rooms shall be separated from the remainder of the building by 2 hours fire barriers.
- d. Aisle width shall not be less than the pile height.

**TABLE 38.4.1.7(4)**  
**STORAGE OF CLASS 4 OXIDIZER LIQUIDS AND SOLIDS**

STORAGE CONFIGURATION	LIMITS (m)
Piles	
Maximum length	3
Maximum width	1.2
Maximum height	2.4
Minimum distance to next pile	2.4
Maximum quantity per building	No Limit

**38.4.1.8 Separation of Class 4 oxidizers from other materials.** In addition to the requirements in Section 25.3.9.8, Class 4 oxidizer liquids and solids shall be separated from other hazardous materials by not less than a 1-hour fire barrier or stored in hazardous materials storage cabinets.

Detached storage buildings for Class 4 oxidizer liquids and solids shall be located a minimum of 15.2 m from other hazardous materials storage.

**38.4.1.9 Contamination.** Liquid and solid oxidizers shall not be stored on or against combustible surfaces. Liquid and solid oxidizers shall be stored in a manner to prevent contamination.

**38.4.2 Outdoor storage.** Outdoor storage of oxidizers in amounts exceeding the maximum allowable quantities per control area set forth in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter. Oxidizing gases shall also comply with Chapter 28.

**38.4.2.1 Distance from storage to exposures for liquid and solid oxidizers.** Outdoor storage areas for liquid and solid oxidizers shall be located in accordance with Table 38.4.1.2.

**38.4.2.2 Distance from storage to exposures for oxidizer gases.** Outdoor storage areas for oxidizer gases shall be located in accordance with Table 38.4.2.2.

**TABLE 38.4.2.2**  
**OXIDIZER GASES – DISTANCE FROM STORAGE TO EXPOSURES<sup>a</sup>**

<b>QUANTITY OF GAS STORED (cubic metre at NTP)</b>	<b>DISTANCE TO A BUILDING NOT ASSOCIATED WITH THE MANUFACTURE OR DISTRIBUTION OF OXIDIZER GASES OR PUBLIC WAY OR LOT LINE THAT CAN BE BUILT UPON (m)</b>	<b>DISTANCE BETWEEN STORAGES AREAS (m)</b>
0 – 1,415.84	1.5	1.5
1,415.87 – 2,831.68	3	3
2,831.71 or greater	4.6	3

- a. The distances do not apply when protective structures having a minimum fire-resistance rating of 2 hours interrupt the line of sight between the storage container and the exposure. The protective structure shall be at least 1.5 m from the exposure. The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

**38.4.2.3 Storage configuration for liquid and solid oxidizers.** Storage configuration for liquid and solid oxidizers shall be in accordance with Tables 38.4.1.7(1) through 38.4.1.7(4).

**38.4.2.4 Storage configuration for oxidizer gases.** Storage configuration for oxidizer gases shall be in accordance with Table 38.4.2.2.

## **SECTION 38.5** **USE**

**38.5.1 Scope.** The use of oxidizers in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter. Oxidizing gases shall also comply with Chapter 28.

## CHAPTER 39 PYROPHORIC MATERIALS

### SECTION 39.1 GENERAL

- 39.1.1 Scope.** The storage and use of pyrophoric materials shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 28.
- 39.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 39.2 DEFINITIONS

- 39.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**PYROPHORIC.** A chemical with an auto-ignition temperature in air, at or below a temperature of 54°C.

### SECTION 39.3 GENERAL REQUIREMENTS

- 39.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of pyrophoric materials in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3, 39.1 and 39.3.
- 39.3.1.1 Emergency shutoff.** Compressed gas systems conveying pyrophoric gases shall be provided with approved emergency shutoff valves that can be activated at each point of use and each source.
- 39.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of pyrophoric materials in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

### SECTION 39.4 STORAGE

- 39.4.1 Indoor storage.** Indoor storage of pyrophoric materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1), shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.  
The storage of silane gas and gas mixtures with a silane concentration of 2 percent or more by volume shall be in accordance with Section 39.6.
- 39.4.1.1 Liquid-tight floor.** In addition to the requirements of Section 25.4.12, floors of storage areas containing pyrophoric liquids shall be of liquid-tight construction.
- 39.4.1.2 Pyrophoric solids and liquids.** Storage of pyrophoric solids and liquids shall be limited to a maximum area of 9.3 m<sup>2</sup> per pile. Storage shall not exceed 1.5 m in height. Individual containers shall not be stacked.  
Aisles between storage piles shall be a minimum of 3 m in width.  
Individual tanks or containers shall not exceed 1,893 L in capacity.



**39.4.1.3 Pyrophoric gases.** Storage of pyrophoric gases shall be in detached buildings where required by Section 25.3.8.2.

**39.4.1.4 Separation from incompatible materials.** In addition to the requirements of Section 25.3.9.8, indoor storage of pyrophoric materials shall be isolated from incompatible hazardous materials by one hour fire barriers with openings protected in accordance with the SBC 100 and 201.

**Exception:** Storage in approved hazardous materials storage cabinets constructed in accordance with Section 25.3.8.7.

**39.4.2 Outdoor storage.** Outdoor storage of pyrophoric materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.

The storage of silane gas, and gas mixtures with a silane concentration of 2 percent or more by volume, shall be in accordance with Section 39.6.

**39.4.2.1 Distance from storage to exposures.** The separation of pyrophoric solids, liquids and gases from buildings, lot lines, public streets, public alleys, public ways or means of egress shall be in accordance with the following:

1. Solids and liquids. Two times the separation required by Chapter 32 for Class IB flammable liquids.
2. Gases. The location and maximum amount of pyrophoric gas per storage area shall be in accordance with Table 39.4.2.1.

**TABLE 39.4.2.1  
PYROPHORIC GASES—DISTANCE FROM STORAGE TO EXPOSURES <sup>a</sup>**

MAXIMUM AMOUNT PER STORAGE AREA (m <sup>3</sup> )	MINIMUM DISTANCE BETWEEN STORAGE AREA (m)	MINIMUM DISTANCE TO LOT LINES OF PROPERTY THAT CAN BE BUILT UPON (m)	MINIMUM DISTANCE TO PUBLIC STREETS, PUBLIC ALLEYS OR PUBLIC WAYS (m)	MINIMUM DISTANCE TO BUILDINGS ON THE SAME PROPERTY		
				Nonrated construction or openings within 7.6 m	Two-hour construction and no openings within 7.6 m	Four-hour construction and no openings within 7.6 m
7.1	1.5	7.6	1.5	1.5	0	0
70.8	3	15.2	3	3	1.5	0
212.4	6.1	30.5	6.1	6.1	3	0

- a. The minimum required distances shall be reduced to 1.5 m when protective structures having a minimum fire resistance of 2 hours interrupt the line of sight between the container and the exposure. The protective structure shall be at least 1.5 m from the exposure. The configuration of the protective structure shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

**39.4.2.2 Weather protection.** When overhead construction is provided for sheltering outdoor storage areas of pyrophoric materials, the storage areas shall be provided with approved automatic fire-extinguishing system protection.

## SECTION 39.5 USE

**39.5.1 General.** The use of pyrophoric materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter.

**39.5.2 Weather protection.** When overhead construction is provided for sheltering of outdoor use areas of pyrophoric materials, the use areas shall be provided with approved automatic fire-extinguishing system protection.

- 39.5.3 Silane gas.** The use of silane gas, and gas mixtures with a silane concentration of 2 percent or more by volume, shall be in accordance with Section 39.6.

## SECTION 39.6 SILANE GAS

- 39.6.1 General requirements.** The storage and use of silane gas and gas mixtures with a silane concentration of 2 percent or more by volume, in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3), shall be in accordance with this section.
- 39.6.1.1 Building construction.** Indoor storage and use of silane gas shall be within a room or building conforming to the SBC 100.
- 39.6.1.2 Flow control.** Compressed gas containers, cylinders and tanks containing silane gas, and gas mixtures with a silane concentration of 2 percent or more by volume, shall be equipped with reduced flow valves equipped with restrictive-flow orifices not exceeding 0.254 mm in diameter. The presence of the restrictive flow orifice shall be indicated on the valve and on the container, cylinder or tank by means of a label placed at a prominent location by the manufacturer.
- Exceptions:**
1. Manufacturing and filling facilities where silane is produced or mixed and stored prior to sale.
  2. Outdoor installations consisting of permanently mounted cylinders connected to a manifold, provided that the outlet connection from the manifold is equipped with a restrictive flow orifice not exceeding 3.2 m in diameter and the setback distance to exposures is not less than 12.2 m. Footnote a of Table 39.4.2.1 shall not apply.
- 39.6.1.3 Valves.** Container, cylinder and tank valves shall be constructed of stainless steel or other approved materials. Valves shall be equipped with outlet fittings in accordance with CGA V-1.
- 39.6.2 Indoor storage.** Indoor storage of silane gas, and gas mixtures with a silane concentration of 2 percent or more by volume, shall be in accordance with Section 39.4.1 and Sections 39.6.2.1 through 39.6.2.3.
- 39.6.2.1 Fire protection.** When automatic fire-extinguishing systems are required, automatic sprinkler systems shall be used.
- 39.6.2.2 Exhausted enclosures or gas cabinets.** When provided, exhausted enclosures and gas cabinets shall be constructed as follows:
1. Exhausted enclosures and gas cabinets shall be in accordance with Sections 25.3.8.5 and 25.3.8.6.
  2. Exhausted enclosures and gas cabinets shall be internally sprinklered.
  3. The velocity of ventilation across unwelded fittings and connections on the piping system shall not be less than 1.02 m/s.
  4. The average velocity at the face of the access ports or windows in the gas cabinet shall not be less than 1.02 m/s with a minimum velocity of 0.76 m/s at any point of the access port or window.
- 39.6.2.3 Emergency power.** The ventilation system shall be provided with an automatic emergency power source in accordance with Section 5D.4 and designed to operate at full capacity.
- 39.6.3 Outdoor storage.** Outdoor storage of silane gas, and gas mixtures with a silane concentration of 2 percent or more by volume, shall be in accordance with Section 39.4.2 and Sections 39.6.3.1 through 39.6.3.3.

- 39.6.3.1 **Volume.** The maximum volume for each nest shall not exceed 283.2 m<sup>3</sup> of gas.
- 39.6.3.2 **Aisles.** Storage nests shall be separated by aisles a minimum of 1.8 m in width.
- 39.6.3.3 **Separation.** Storage shall be located a minimum of 7.6 m from lot lines, public streets, public alleys, public ways, means of egress or buildings.
- 39.6.3.4 **Weather protection.** The clear height of overhead construction provided for sheltering of outdoor storage shall not be less than 3.7 m.
  
- 39.6.4 **Indoor use and dispensing.** The indoor use and dispensing of silane gas and gas mixtures with a silane concentration of 2 percent or more by volume, in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) shall be in accordance with Sections 39.5 and this section.
  - 39.6.4.1 **Exhausted enclosures or gas cabinets.** When provided, exhausted enclosures and gas cabinets shall be installed in accordance with Section 39.6.2.2.
  - 39.6.4.2 **Remote manual shutdown.** Remote manual shutdown of process gas flow shall be provided outside each gas cabinet.
  - 39.6.4.3 **Emergency power.** The ventilation system shall be provided with an approved automatic emergency power source in accordance with Section 5D.4 and designed to operate at full capacity.
  - 39.6.4.4 **Purge panels.** Automated purge panels shall be provided.
  - 39.6.4.4.1 **Purge gases.** Purging of piping and controls located in gas cabinets or exhausted enclosures shall only be performed using a dedicated inert gas supply that is designed to prevent silane from entering the inert gas supply. The use of non-dedicated systems or portions of piping systems is allowed on portions of the venting system that are continuously vented to atmosphere. Devices that could interrupt the continuous flow of purge gas to the atmosphere shall be prohibited.  
**Exception:** Manufacturing and filling facilities where silane is produced or mixed.
  - 39.6.4.4.2 **Venting.** Gas vent headers or individual purge panel vent lines shall have a continuous flow of inert gas. The inert gas shall be introduced upstream of the first vent or exhaust connection to the header.
  - 39.6.4.4.3 **Purging operations.** Purging operations shall be performed by means ensuring complete purging of the piping and control system before the system is opened to the atmosphere.
  
- 39.6.5 **Outdoor use and dispensing.** The outdoor use and dispensing of silane gas, and gas mixtures with a silane concentration of 2 percent or more by volume, exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 39.5, 39.6.4 and 39.6.5.1.
- 39.6.5.1 **Outdoor use weather protection.** When overhead construction is provided for sheltering outdoor use areas containing silane gas, or gas mixtures with a silane concentration of 2 percent or more by volume, the use areas shall be provided with approved automatic fire-extinguishing system protection.

## CHAPTER 40 PYROXYLIN (CELLULOSE NITRATE) PLASTICS

### SECTION 40.1 GENERAL

- 40.1.1 Scope.** This chapter shall apply to the storage and handling of plastic substances, materials or compounds with cellulose nitrate as a base, by whatever name known, in the form of blocks, sheets, tubes or fabricated shapes. Cellulose nitrate motion picture film shall comply with the requirements of Section 5A.6.
- 40.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 40.2 DEFINITIONS

- 40.2.1 Terms defined in Chapter 1.** Words and terms used in this chapter and defined in Chapter 1 shall have the meanings ascribed to them as defined therein.

### SECTION 40.3 GENERAL REQUIREMENTS

- 40.3.1 Displays.** Cellulose nitrate (pyroxylin) plastic articles are allowed to be placed on tables not more than 0.9 m wide and 3 m long. Tables shall be spaced at least 0.9 m apart. Where articles are displayed on counters, they shall be arranged in a like manner.
- 40.3.2 Space under tables.** Spaces underneath tables shall be kept free from storage of any kind and accumulation of paper, refuse and other combustible material.
- 40.3.3 Location.** Sales or display tables shall be so located that in the event of a fire at the table, the table will not interfere with free means of egress from the room in at least one direction.
- 40.3.4 Lighting.** Lighting shall not be located directly above cellulose nitrate (pyroxylin) plastic material, unless provided with a suitable guard to prevent heated particles from falling.

### SECTION 40.4 STORAGE AND HANDLING

- 40.4.1 Raw material.** Raw cellulose nitrate (pyroxylin) plastic material in a Group F building shall be stored and handled in accordance with Sections 40.4.1.1 through 40.4.1.7.
- 40.4.1.1 Storage of incoming material.** Where raw material in excess of 11 kg is received in a building or fire area, an approved vented cabinet or approved vented vault equipped with an approved automatic sprinkler system shall be provided for the storage of material.
- 40.4.1.2 Capacity limitations.** Cabinets in any one work-room shall not contain more than 454 kg of raw material. Each cabinet shall not contain more than 227 kg. Each compartment shall not contain more than 114 kg.

- 40.4.1.3 Storage of additional material.** Raw material in excess of that allowed by Section 40.4.1.2 shall be kept in vented vaults not exceeding 43 m<sup>3</sup> capacity of total vault space, and with approved construction, venting and sprinkler protection.
- 40.4.1.4 Heat sources.** Cellulose nitrate (pyroxylin) plastic shall not be stored within 0.61 m of heat-producing appliances, steam pipes, radiators or chimneys.
- 40.4.1.5 Accumulation of material.** In factories manufacturing articles of cellulose nitrate (pyroxylin) plastics, approved sprinklered and vented cabinets, vaults or storage rooms shall be provided to prevent the accumulation in workrooms of raw stock in process or finished articles.
- 40.4.1.6 Operators.** In workrooms of cellulose nitrate (pyroxylin) plastic factories, operators shall not be stationed closer together than 0.9 m, and the amount of material per operator shall not exceed one-shift's supply and shall be limited to the capacity of three tote boxes, including material awaiting removal or use.
- 40.4.1.7 Waste material.** Waste cellulose nitrate (pyroxylin) plastic materials such as shavings, chips, turnings, sawdust, edgings and trimmings shall be kept under water in metal receptacles until removed from the premises.
- 40.4.2 Fire protection.** The manufacture or storage of articles of cellulose nitrate (pyroxylin) plastic in quantities exceeding 45 kg shall be located in a building or portion thereof equipped throughout with an approved automatic sprinkler system in accordance with Section 7.3.3.1.1.
- 40.4.3 Sources of ignition.** Sources of ignition shall not be located in rooms in which cellulose nitrate (pyroxylin) plastic in excess of 11 kg is handled or stored.
- 40.4.4 Heating.** Rooms in which cellulose nitrate (pyroxylin) plastic is handled or stored shall be heated by low-pressure steam or hot water radiators.

## CHAPTER 41 UNSTABLE (REACTIVE) MATERIALS

### SECTION 41.1 GENERAL

- 41.1.1 Scope.** The storage and use of unstable (reactive) materials shall be in accordance with this chapter. Compressed gases shall also comply with Chapter 28.
- Exceptions:**
1. Display and storage in Group M and storage in Group S occupancies complying with Section 25.3.11.
  2. Detonable unstable (reactive) materials shall be stored in accordance with Chapter 31.
- 41.1.2 Permits.** Permits shall be required as set forth in SBC 100.

### SECTION 41.2 DEFINITIONS

- 41.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**UNSTABLE (REACTIVE) MATERIAL.** A material, other than an explosive, which in the pure state or as commercially produced, will vigorously polymerize, decompose, condense or become self-reactive and undergo other violent chemical changes, including explosion, when exposed to heat, friction or shock, or in the absence of an inhibitor, or in the presence of contaminants, or in contact with incompatible materials. Unstable (reactive) materials are subdivided as follows:

**Class 4.** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This class includes materials that are sensitive to mechanical or localized thermal shock at normal temperatures and pressures.

**Class 3.** Materials that in themselves are capable of detonation or of explosive decomposition or explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. This class includes materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

**Class 2.** Materials that in themselves are normally unstable and readily undergo violent chemical change but do not detonate. This class includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures, and that can undergo violent chemical change at elevated temperatures and pressures.

**Class 1.** Materials that in themselves are normally stable but which can become unstable at elevated temperatures and pressure.

### SECTION 41.3 GENERAL REQUIREMENTS

- 41.3.1 Quantities not exceeding the maximum allowable quantity per control area.** Quantities of unstable (reactive) materials not exceeding the maximum allowable quantity per control area shall be in accordance with Sections 41.3.1.1 through 41.3.1.2.5.

- 41.3.1.1 General.** The storage and use of unstable (reactive) materials in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3, 41.1 and 41.3.
- 41.3.1.2 Limitations for indoor storage and use by occupancy.** The indoor storage of unstable (reactive) materials shall be in accordance with Sections 41.3.1.2.1 through 41.3.1.2.5.
- 41.3.1.2.1 Group A, E, I or U occupancies.** In Group A, E, I or U occupancies, any amount of Class 3 and 4 unstable (reactive) materials shall be stored in accordance with the following:
1. Class 3 and 4 unstable (reactive) materials shall be stored in hazardous material storage cabinets complying with Section 25.3.8.7.
  2. The hazardous material storage cabinets shall not contain other storage.
- 41.3.1.2.2 Group R occupancies.** Class 3 and 4 unstable (reactive) materials shall not be stored or used within Group R occupancies.
- 41.3.1.2.3 Group M occupancies.** Class 4 unstable (reactive) materials shall not be stored or used in retail sales portions of Group M occupancies.
- 41.3.1.2.4 Offices.** Class 3 and 4 unstable (reactive) materials shall not be stored or used in offices of Group B, F, M or S occupancies.
- 41.3.1.2.5 Classrooms.** In classrooms in Group B, F or M occupancies, any amount of Class 3 and 4 unstable (reactive) materials shall be stored in accordance with the following:
1. Class 3 and 4 unstable (reactive) materials shall be stored in hazardous material storage cabinets complying with Section 25.3.8.7.
  2. The hazardous material storage cabinets shall not contain other storage.
- 41.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of unstable (reactive) materials in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

## SECTION 41.4 STORAGE

- 41.4.1 Indoor storage.** Indoor storage of unstable (reactive) materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter. In addition, Class 3 and 4 unstable (reactive) detonable materials shall be stored in accordance with these code requirements and SBC 201 for explosives.
- 41.4.1.1 Detached storage.** Storage of unstable (reactive) materials shall be in detached buildings when required in Section 25.3.8.2.
- 41.4.1.2 Explosion control.** Indoor storage rooms, areas and buildings containing Class 3 or 4 unstable (reactive) materials shall be provided with explosion control in accordance with Section 7.11.
- 41.4.1.3 Liquid-tight floor.** In addition to Section 25.4.12, floors of storage areas for liquids and solids shall be of liquid-tight construction.
- 41.4.1.4 Storage configuration.** Unstable (reactive) materials stored in quantities greater than 14 m<sup>3</sup> shall be separated into piles, each not larger than 14 m<sup>3</sup>. Aisle width shall not be less than the height of the piles or 1.2 m, whichever is greater.  
**Exception:** Materials stored in tanks.
- 41.4.1.5 Location in building.** Unstable (reactive) materials shall not be stored in basements.

- 41.4.2 Outdoor storage.** Outdoor storage of unstable (reactive) materials in amounts exceeding the maximum allowable quantities per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.
- 41.4.2.1 Distance from storage to exposures.** Outdoor storage of unstable (reactive) material that can deflagrate shall not be within 22.9 m of buildings, lot lines, public streets, public alleys, public ways or means of egress. Outdoor storage of nondeflagrating unstable (reactive) materials shall not be within 6.1 m of buildings, lot lines, public streets, public alleys, public ways or means of egress. A 2-hour fire barrier wall without openings or penetrations extending not less than 762 mm above and to the sides of the storage is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.
- 41.4.2.2 Storage configuration.** Piles of unstable (reactive) materials shall not exceed 28 m<sup>3</sup>.
- 41.4.2.3 Aisle widths.** Aisle widths between piles shall not be less than one-half the height of the pile or 3 m, whichever is greater.

## SECTION 41.5

### USE

- 41.5.1 General.** The use of unstable (reactive) materials in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter.



## CHAPTER 42

### WATER-REACTIVE SOLIDS AND LIQUIDS

#### SECTION 42.1

##### GENERAL

- 42.1.1 Scope.** The storage and use of water-reactive solids and liquids shall be in accordance with this chapter.
- Exceptions:**
1. Display and storage in Group M and storage in Group S occupancies complying with Section 25.3.11.
  2. Detonable water-reactive solids and liquids shall be stored in accordance with Chapter 31.
- 42.1.2 Permits.** Permits shall be required as set forth in SBC 100.

#### SECTION 42.2

##### DEFINITIONS

- 42.2.1 Definition.** The following word and term shall, for the purposes of this chapter and as used elsewhere in these code requirements, have the meaning shown herein.

**WATER-REACTIVE MATERIAL.** A material that explodes; violently reacts; produces flammable, toxic or other hazardous gases; or evolves enough heat to cause self-ignition or ignition of nearby combustibles upon exposure to water or moisture. Water-reactive materials are subdivided as follows:

**Class 3.** Materials that react explosively with water without requiring heat or confinement.

**Class 2.** Materials that may form potentially explosive mixtures with water.

**Class 1.** Materials that may react with water with some release of energy, but not violently.

#### SECTION 42.3

##### GENERAL REQUIREMENTS

- 42.3.1 Quantities not exceeding the maximum allowable quantity per control area.** The storage and use of water-reactive solids and liquids in amounts not exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Sections 25.1, 25.3, 42.1 and 42.3.
- 42.3.2 Quantities exceeding the maximum allowable quantity per control area.** The storage and use of water-reactive solids and liquids in amounts exceeding the maximum allowable quantity per control area indicated in Section 25.3.1 shall be in accordance with Chapter 25 and this chapter.

#### SECTION 42.4

##### STORAGE

- 42.4.1 Indoor storage.** Indoor storage of water-reactive solids and liquids in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.

- 42.4.1.1 Detached storage.** Storage of water-reactive solids and liquids shall be in detached buildings when required by Section 25.3.8.2.
- 42.4.1.2 Liquid-tight floor.** In addition to the provisions of Section 25.4.12, floors in storage areas for water-reactive solids and liquids shall be of liquid-tight construction.
- 42.4.1.3 Waterproof room.** Rooms or areas used for the storage of water-reactive solids and liquids shall be constructed in a manner which resists the penetration of water through the use of waterproof materials. Piping carrying water for other than approved automatic sprinkler systems shall not be within such rooms or areas.
- 42.4.1.4 Water-tight containers.** When Class 3 water-reactive solids and liquids are stored in areas equipped with an automatic sprinkler system, the materials shall be stored in closed water-tight containers.
- 42.4.1.5 Storage configuration.** Water-reactive solids and liquids stored in quantities greater than 14 m<sup>3</sup> shall be separated into piles, each not larger than 14 m<sup>3</sup>. Aisle widths between piles shall not be less than the height of the pile or 1.2 m, whichever is greater.
- Exception:** Water-reactive solids and liquids stored in tanks.  
 Class 2 water-reactive solids and liquids shall not be stored in basements unless such materials are stored in closed water-tight containers or tanks.  
 Class 3 water-reactive solids and liquids shall not be stored in basements.  
 Class 2 or 3 water-reactive solids and liquids shall not be stored with flammable liquids.
- 42.4.1.6 Explosion control.** Indoor storage rooms, areas and buildings containing Class 2 or 3 water-reactive solids and liquids shall be provided with explosion control in accordance with Section 7.11.
- 42.4.2 Outdoor storage.** Outdoor storage of water-reactive solids and liquids in quantities exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.4 and this chapter.
- 42.4.2.1 General.** Outdoor storage of water-reactive solids and liquids shall be within tanks or closed water-tight containers and shall be in accordance with Sections 42.4.2.2 through 42.4.2.5.
- 42.4.2.2 Class 3 distance to exposures.** Outdoor storage of Class 3 water-reactive solids and liquids shall not be within 22.9 m of buildings, lot lines, public streets, public alleys, public ways or means of egress.
- 42.4.2.3 Class 2 distance to exposures.** Outdoor storage of Class 2 water-reactive solids and liquids shall not be within 6.1 m of buildings, lot lines, public streets, public alleys, public ways or means of egress. A 2 hours fire barrier wall without openings or penetrations, and extending not less than 762 mm above and to the sides of the storage area is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.
- 42.4.2.4 Storage conditions.** Class 3 water-reactive solids and liquids shall be limited to piles not greater than 14 m<sup>3</sup>.  
 Class 2 water-reactive solids and liquids shall be limited to piles not greater than 28 m<sup>3</sup>.  
 Aisle widths between piles shall not be less than one-half the height of the pile or 3 m, whichever is greater.
- 42.4.2.5 Containment.** Secondary containment shall be provided in accordance with the provisions of Section 25.4.2.2.

**SECTION 42.5**  
**USE**

- 42.5.1 General.** The use of water-reactive solids and liquids in amounts exceeding the maximum allowable quantity per control area indicated in Table 25.3.1.1(1) or 25.3.1.1(3) shall be in accordance with Sections 25.1, 25.3, 25.5 and this chapter.

## APPENDIX A

### REFERENCED STANDARDS

These are the standards referenced within SBC 801. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title. The application of the referenced standards shall be as specified in SBC.

1. AASHTO, HB-16—1996, Standard Specification for Highway Bridges, 16th edition — with 1997 through 2000 Interim Revisions, American Association of State Highway, and Transportation Officials, 444 North Capitol Street, Northwest, #249, Washington, DC 20001.
2. AFSI, ASI—77, Design and Standard Manual, American Association of State Highway, and Transportation Officials, 444 North Capitol Street, Northwest, #249, Washington, DC 20001, Architectural Fabric Structures Institute, c/o Industrial Fabric Association International, 1801 County Road B West, Roseville, MN 55113.
3. ANSI, A13.1—96, Scheme for the Identification of Piping Systems, American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
4. ANSI, B31.3—99, Process Piping, including addendum, American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
5. ANSI, B31.9—96, Building Services Piping Code for Pressure Piping, American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
6. API, Spec 12P—1995, Specification for Fiberglass Reinforced Plastic Tanks, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
7. API, RP 651—1997, Cathodic Protection of Aboveground Petroleum Storage Tanks, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
8. API, Std 653—1998, Tank Inspection, Repair, Alteration and Reconstruction, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
9. API, RP 752—1995, Management of Hazards Associated with Location of Process Plant Buildings, CMA Managers Guide, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
10. API, RP 1604—1996, Closure of Underground Petroleum Storage Tanks, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
11. API, RP 1615—1996, Installation of Underground Petroleum Storage Systems, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
12. API, Std 2000—1998, Venting Atmosphere and Low Pressure Storage Tanks: Nonrefrigerated and Refrigerated, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
13. API, RP 2001—1998, Fire Protection in Refineries, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
14. API, RP 2003—1998, Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
15. API, Publ 2009—1995, Safe Welding and Cutting Practices in Refineries, Gas Plants and Petrochemical Plants, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
16. API, Std 2015—1994, Safe Entry and Clearing of Petroleum Storage Tanks, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
17. API, Publ 2028—1991, Flame Arrestors in Piping Systems, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
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19. API, Publ 2201—1995, Procedures for Welding or Hot Tapping on Equipment in Service, American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.
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**APPENDIX B  
FIRE-FLOW REQUIREMENTS FOR BUILDINGS**

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

**SECTION B1  
GENERAL**

- B1.1 Scope.** The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

**SECTION B2  
DEFINITIONS**

- B2.1 Definitions.** For the purpose of this appendix, certain terms are defined as follows:

**FIRE FLOW.** The flow rate of a water supply, measured at 138 kPa residual pressure, that is available for fire fighting.

**FIRE-FLOW CALCULATION AREA.** The floor area, in square meter, used to determine the required fire flow.

**SECTION B3  
MODIFICATIONS**

- B3.1 Decreases.** The building code official is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.
- B3.2 Increases.** The building chief is authorized to increase the fire-flow requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall not be more than twice that required for the building under consideration.
- B3.3 Areas without water supply systems.** For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the building code official is authorized to utilize NFPA 1142.

**SECTION B4  
FIRE AREA**

- B4.1 General.** The fire-flow calculation area shall be the total floor area of all floor levels within the exterior walls, and under the horizontal projections of the roof of a building, except as modified in Section B4.3.
- B4.2 Area separation.** Portions of buildings which are separated by fire walls without openings, constructed in accordance with these code requirements and the SBC 201, are allowed to be considered as separate fire-flow calculation areas.

- B4.3 Type IA and Type IB construction.** The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.
- Exception:** Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

## SECTION B5 FIRE-FLOW REQUIREMENTS FOR BUILDINGS

- B5.1 One- and two-family dwellings.** The minimum fire-flow requirements for one- and two-family dwellings having a fire-flow calculation area which does not exceed 344.5 m<sup>2</sup> shall be 3,785.4 L/min. Fire flow and flow duration for dwellings having a fire-flow calculation area in excess of 344.5 m<sup>2</sup> shall not be less than that specified in Table B5.1.
- Exception:** A reduction in required fire flow of 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system.
- B5.2 Buildings other than one- and two-family dwellings.** The minimum fire flow and flow duration for buildings other than one- and two-family dwellings shall be as specified in Table B5.1.
- Exception:** A reduction in required fire flow of up to 50 percent, as approved, is allowed when the building is provided with an approved automatic sprinkler system installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 of these code requirements. Where buildings are also of Type I or II construction and are a light-hazard occupancy as defined by NFPA 13, the reduction may be up to 75 percent. The resulting fire flow shall not be less than 5,678 L/min for the prescribed duration as specified in Table B 5.1.

**TABLE B5.1**  
**MINIMUM REQUIRED FIRE FLOW AND FLOW DURATION FOR BUILDINGS<sup>a</sup>**

FIRE-FLOW CALCULATION AREA (square meters)					FIRE FLOW (liters per minute) <sup>c</sup>	FLOW DURATION (hours)
Type IA and IB <sup>b</sup>	Type IIA and IIIA <sup>b</sup>	Type IV and V-A <sup>b</sup>	Type IIB and IIIB <sup>b</sup>	Type V-B <sup>b</sup>		
0-2,109	0-1,180	0-762	0-548	0-334	5,678	2
2,110-2,806	1,181-1,579	763-1,013	549-734	334-446	6,624	
2,807-3,595	1,580-2,025	1,014-1,198	735-910	447-576	7,570	
3,596-4,487	2,026-2,248	1,190-1,616	911-1,171	577-715	8,516	
4,488-5,481	2,249-3,084	1,617-1,979	1,172-1,431	716-873	9,463	
5,482-6,587	3,085-3,688	1,980-2,369	1,432-1,709	874-1,050	10,409	
6,588-7,776	3,689-4,376	2,370-2,796	1,710-2,025	1,051-1,245	11,355	3
7,777-9,076	4,377-5,100	2,797-3,270	2,026-2,406	1,246-1,449	12,301	
9,077-10,470	5,101-5,890	3,271-3,772	2,407-2,722	1,450-1,672	13,248	
10,471-11,956	5,891-6,726	3,773-4,311	2,723-3,112	1,673-1,914	14,194	
11,957-13,554	6,727-7,627	4,312-4,877	3,113-3,521	1,915-2,165	15,140	4
13,555-15,254	7,628-8,584	4,878-5,490	3,522-3,967	2,166-2,443	16,086	
15,255-17,038	8,585-9,578	5,491-6,131	3,968-4,431	2,444-2,772	17,033	
17,039-18,924	9,579-10,646	6,132-6,810	4,432-4,924	2,773-3,029	17,979	
18,925-20,921	10,647-11,770	6,811-7,534	4,925-5,444	3,030-3,344	18,925	
20,922-23,011	11,771-12,950	7,535-8,287	5,445-6,076	3,345-3,679	19,871	
23,012-25,194	12,951-14,177	8,288-9,076	6,077-6,559	3,680-4,032	20,818	
25,195-27,489	14,178-15,468	9,077-9,894	6,560-7,153	4,033-4,403	21,764	
27,490-Greater	15,469-Greater	9,895-10,758	7,154-7,776	4,404-4,784	22,710	
—	—	10,759-11,659	7,777-8,417	4,785-5,175	23,656	
—	—	11,660-12,588	8,418-9,095	5,176-5,593	24,603	
—	—	12,589-13,545	9,096-9,922	5,594-6,020	25,549	
—	—	13,546-14,557	9,923-10,516	6,021-6,466	26,495	
—	—	14,558-15,598	10,517-11,269	6,467-6,930	27,441	
—	—	15,590-16,666	11,270-12,040	6,931-7,413	28,388	
—	—	16,667-17,781	12,041-12,848	7,414-7,906	29,334	
—	—	17,782-Greater	12,849-Greater	7,907-Greater	30,280	

a. The minimum required fire flow shall be permitted to be reduced by 25 percent for Use Group R.

b. Types of construction are based on Chapter 4.

c. Measured at 827 kPa.

**APPENDIX C**  
**FIRE HYDRANT LOCATIONS AND DISTRIBUTION**

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

**SECTION C1**  
**GENERAL**

- C1.1**      **Scope.** Fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed.

**SECTION C2**  
**LOCATION**

- C2.1**      **Fire hydrant locations.** Fire hydrants shall be provided along required fire apparatus access roads and adjacent public streets.

**SECTION C3**  
**NUMBER OF FIRE HYDRANTS**

- C3.1**      **Fire hydrants available.** The minimum number of fire hydrants available to a building shall not be less than that listed in Table C5.1. The number of fire hydrants available to a complex or subdivision shall not be less than that determined by spacing requirements listed in Table C5.1 when applied to fire apparatus access roads and perimeter public streets from which fire operations could be conducted.

**SECTION C4**  
**CONSIDERATION OF EXISTING FIRE HYDRANTS**

- C4.1**      **Existing fire hydrants.** Existing fire hydrants on public streets are allowed to be considered as available. Existing fire hydrants on adjacent properties shall not be considered available unless fire apparatus access roads extend between properties and easements are established to prevent obstruction of such roads.

**SECTION C5**  
**DISTRIBUTION OF FIRE HYDRANTS**

- C5.1**      **Hydrant spacing.** The average spacing between fire hydrants shall not exceed that listed in Table C5.1.  
**Exception:** The building chief is authorized to accept a deficiency of up to 10 percent where existing fire hydrants provide all or a portion of the required fire hydrant service.  
Regardless of the average spacing, fire hydrants shall be located such that all points on streets and access roads adjacent to a building are within the distances listed in Table C5.1.



**TABLE C5.1**  
**NUMBER AND DISTRIBUTION OF FIRE HYDRANTS**

<b>FIRE-FLOW REQUIREMENT (L/m)</b>	<b>MINIMUM NUMBER OF HYDRANTS</b>	<b>AVERAGE SPACING BETWEEN HYDRANTS<sup>a, b, c</sup> (meters)</b>	<b>MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT<sup>d</sup></b>
6,624 or less	1	152	76
7,570-8,516	2	137	69
9,463	3	137	69
11,355	3	122	69
13,248-15,140	4	107	64
17,033-18,925	5	91	55
20,818	6	91	55
22,710	6	76	46
24,603-26,495	7	76	46
28,388 or more	8 or more <sup>e</sup>	61	37

- a. Reduce by 30.5 m for dead-end streets or roads.
- b. Where streets are provided with median dividers which can be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 152 m on each side of the street and be arranged on an alternating basis up to a fire-flow requirement of 26,495 liters per minute and 122 m for higher fire-flow requirements.
- c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 305 m to provide for transportation hazards.
- d. Reduce by 15.2 m for dead-end streets or roads.
- e. One hydrant for each 3,785 liters per minute or fraction thereof.

## APPENDIX D FIRE APPARATUS ACCESS ROADS

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

### SECTION D1 GENERAL

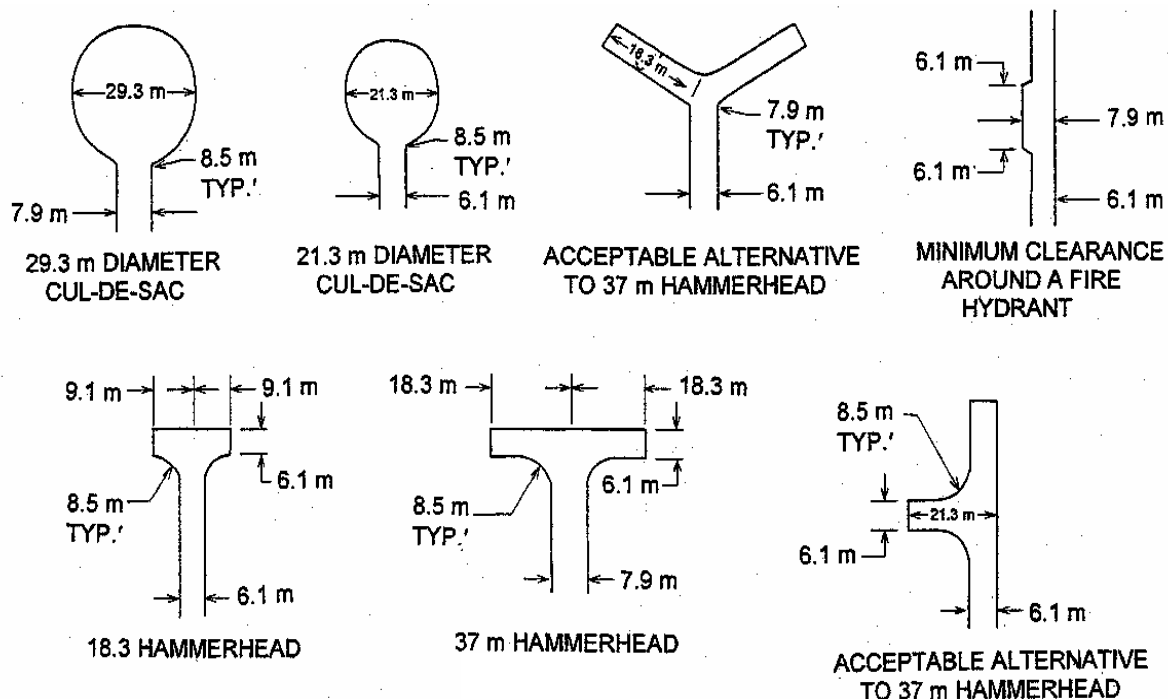
- D1.1 Scope.** Fire apparatus access roads shall be in accordance with this appendix and all other applicable requirements of these code requirements.

### SECTION D2 REQUIRED ACCESS

- D2.1 Access and loading.** Facilities, buildings or portions of buildings hereafter constructed shall be accessible to fire department apparatus by way of an approved fire apparatus access road with an asphalt, concrete or other approved driving surface capable of supporting the imposed load of fire apparatus weighing at least 34,050 kg.

### SECTION D3 MINIMUM SPECIFICATIONS

- D3.1 Access road width with a hydrant.** Where a fire hydrant is located on a fire apparatus access road, the minimum road width shall be 7.9 m. See Figure D3.1.



**FIGURE D3.1  
DEAD-END FIRE APPARATUS ACCESS ROAD TURNAROUND**

- D3.2 Grade.** Fire apparatus access roads shall not exceed 10 percent in grade.  
**Exception:** Grades steeper than 10 percent as approved by the building code official.
- D3.3 Turning radius.** The minimum turning radius shall be determined by the building code official.
- D3.4 Dead ends.** Dead-end fire apparatus access roads in excess of 46 m shall be provided with width and turnaround provisions in accordance with Table D3.4.

**TABLE D3.4**  
**REQUIREMENTS FOR DEAD-END FIRE APPARATUS ACCESS ROADS**

<b>LENGTH (meters)</b>	<b>WIDTH (meters)</b>	<b>TURNAROUNDS REQUIRED</b>
0–46	6.1	None required
47–152	6.1	37-meters Hammerhead, 18.3-meters “Y” or 29.3-meters-diameter cul-de-sac in accordance with Figure D3.1
153–229	7.9	37-meters Hammerhead, 18.3-meters “Y” or 29.3-meters-diameter cul-de-sac in accordance with Figure D3.1
Over 229	Special approval required	

- D3.5 Fire apparatus access road gates.** Gates securing the fire apparatus access roads shall comply with all of the following criteria:
1. The minimum gate width shall be 6.1 m.
  2. Gates shall be of the swinging or sliding type.
  3. Construction of gates shall be of materials that allow manual operation by one person.
  4. Gate components shall be maintained in an operative condition at all times and replaced or repaired when defective.
  5. Electric gates shall be equipped with a means of opening the gate by fire department personnel for emergency access. Emergency opening devices shall be approved by the fire code official.
  6. Manual opening gates shall not be locked with a padlock or chain and padlock unless they are capable of being opened by means of forcible entry tools.
  7. Locking device specifications shall be submitted for approval by the building code official.
- D3.6 Signs.** Where required by the building code official, fire apparatus access roads shall be marked with permanent NO PARKING – FIRE LANE signs complying with Figure D3.6. Signs shall have a minimum dimension of 305 mm wide by 457 mm high and have red letters on a white reflective background. Signs shall be posted on one or both sides of the fire apparatus road as required by Section D3.6.1 or D3.6.2.
- D3.6.1 Roads 6.1 to 7.9 meters in width.** Fire apparatus access roads 6.1 to 7.9 meters wide shall be posted on both sides as a fire lane.
- D3.6.2 Roads more than 7.9 meters in width.** Fire apparatus access roads more than 7.9 meters wide to 9.7 meters wide shall be posted on one side of the road as a fire lane.

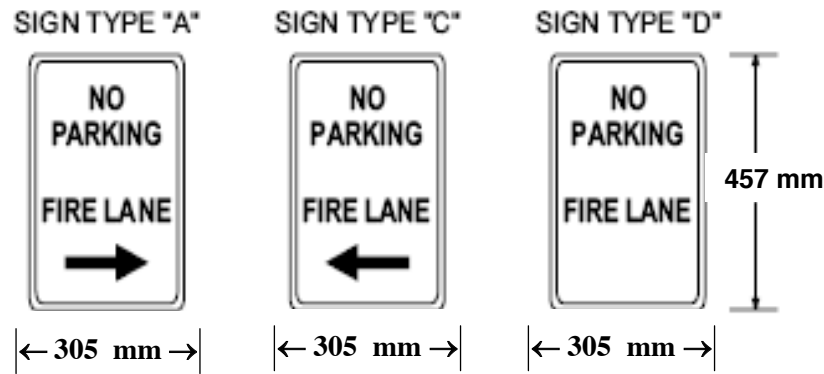


FIGURE D3.6. FIRE LANE SIGNS

#### SECTION D4 COMMERCIAL AND INDUSTRIAL DEVELOPMENTS

- D4.1 Buildings exceeding three stories or 9.1 meters in height.** Buildings or facilities exceeding 9.1 meters or three stories in height shall have at least three means of fire apparatus access for each structure.
- D4.2 Buildings exceeding 5,760 square meters in area.** Buildings or facilities having a gross building area of more than 5,760 m<sup>2</sup> shall be provided with two separate and approved fire apparatus access roads.  
**Exception:** Projects having a gross building area of up to 11,520 m<sup>2</sup> that have a single approved fire apparatus access road when all buildings are equipped throughout with approved automatic sprinkler systems.
- D4.3 Remoteness.** Where two access roads are required, they shall be placed a distance apart equal to not less than one half of the length of the maximum overall diagonal dimension of the property or area to be served, measured in a straight line between accesses.

#### SECTION D5 AERIAL FIRE APPARATUS ACCESS ROADS

- D5.1 Where required.** Buildings or portions of buildings or facilities exceeding 9.1 m in height above the lowest level of fire department vehicle access shall be provided with approved fire apparatus access roads capable of accommodating fire department aerial apparatus. Overhead utility and power lines shall not be located within the aerial fire apparatus access roadway.
- D5.2 Width.** Fire apparatus access roads shall have a minimum unobstructed width of 7.9 m in the immediate vicinity of any building or portion of building more than 9.1 m in height.
- D5.3 Proximity to building.** At least one of the required access routes meeting this condition shall be located within a minimum of 4.6 m and a maximum of 9.1 m from the building, and shall be positioned parallel to one entire side of the building.

**SECTION D6**  
**MULTIPLE-FAMILY RESIDENTIAL DEVELOPMENTS**

- D6.1**      **Projects having more than 100 dwelling units.** Multiple-family residential projects having more than 100 dwelling units shall be equipped throughout with two separate and approved fire apparatus access roads.  
**Exception:** Projects having up to 200 dwelling units may have a single approved fire apparatus access road when all buildings, including nonresidential occupancies, are equipped throughout with approved automatic sprinkler systems installed in accordance with Section 7.3.3.1.1 or 7.3.3.1.2 of these code requirements.
- D6.2**      **Projects having more than 200 dwelling units.** Multiple-family residential projects having more than 200 dwelling units shall be provided with two separate and approved fire apparatus access roads regardless of whether they are equipped with an approved automatic sprinkler system.

**SECTION D7**  
**ONE- OR TWO-FAMILY RESIDENTIAL DEVELOPMENTS**

- D7.1**      **One- or two-family dwelling residential developments.** Developments of one- or two-family dwellings where the number of dwelling units exceeds 30 shall be provided with separate and approved fire apparatus access roads, and shall meet the requirements of Section D4.3.
- Exceptions:**
1. Where there are 30 or fewer dwelling units on a single public or private access way and all dwelling units are protected by approved residential sprinkler systems, access from two directions shall not be required.
  2. The number of dwelling units on a single fire apparatus access road shall not be increased unless fire apparatus access roads will connect with future development, as determined by the building code official.

## APPENDIX E HAZARD CATEGORIES

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

### SECTION E1 GENERAL

- E1.1 Scope.** This appendix provides information, explanations and examples to illustrate and clarify the hazard categories contained in Chapter 25 of these code requirements.  
This appendix should not be used as the sole means of hazardous materials classification.

### SECTION E2 HAZARD CATEGORIES

- E2.1 Physical hazards.** Materials classified in this section pose a physical hazard.
- E2.1.1 Explosives and blasting agents.** The UN/DOT classification system classifies all explosives as Class 1 materials. They are then divided into six separate divisions to indicate their relative hazard. Table 31.4.3 provides some guidance with regard to this classification. Some items may appear in more than one division, depending on factors such as the degree of confinement or separation, by type of packaging, storage configuration or state of assembly.
- In order to determine the level of hazard presented by explosive materials, testing to establish quantitatively their explosive nature is required. There are numerous test methods that have been used to establish the character of an explosive material. Standardized tests, required for finished goods containing explosives or explosive materials in a packaged form suitable for shipment or storage, have been established by UN/DOT and BATF. However, these tests do not consider key elements that should be examined in a manufacturing situation. In manufacturing operations, the condition and/or the state of a material may vary within the process. The in-process material classification and classification requirements for materials used in the manufacturing process may be different from the classification of the same material when found in finished goods depending on the stage of the process in which the material is found. A classification methodology must be used that recognizes the hazards commensurate with the application to the variable physical conditions as well as potential variations of physical character and type of explosive under consideration. Test methods or guidelines for hazard classification of energetic materials used for in-process operations shall be approved by the building code official. Test methods used shall be in accordance with an approved criteria. The results of such testing shall become a portion of the files of the jurisdiction and be included as an independent section of any Hazardous Materials Management Plan (HMMP) required by Section 31.5.2.1. Examples of materials in various Divisions are as follows:
- 1. Division 1.1 (High Explosives).** Consists of explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire pile of material instantaneously. Includes substances that, when tested in accordance with approved methods, can be caused to detonate by means of a blasting cap when unconfined or will transition from deflagration to a

- detonation when confined or unconfined. Examples: dynamite, TNT, nitroglycerine, C-3, HMX, RDX, encased explosives, military ammunition.
2. Division 1.2 (Low Explosives). Consists of explosives that have a projection hazard, but not a mass explosion hazard. Examples: nondetonating encased explosives, military ammunition and the like.
  3. Division 1.3 (Low Explosives). Consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. The major hazard is radiant heat or violent burning, or both. Can be deflagrated when confined. Examples: smokeless powder, propellant explosives, display fireworks.
  4. Division 1.4. Consists of explosives that pose a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is expected. An internal fire must not cause virtually instantaneous explosion of almost the entire contents of the package. Examples: squibs (nondetonating igniters), explosive actuators, explosive trains (low level detonating cord).
  5. Division 1.5 (Blasting Agents). Consists of very insensitive explosives. This division is comprised of substances which have a mass explosion hazard, but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport. Materials are not cap sensitive; however, they are mass detonating when provided with sufficient input. Examples: oxidizer and liquid fuel slurry mixtures and gels, ammonium nitrate combined with fuel oil.
  6. Division 1.6. Consists of extremely insensitive articles which do not have a mass explosive hazard. This division is comprised of articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation. Although this category of materials has been defined, the primary application is currently limited to military uses. Examples: Low vulnerability military weapons.

Explosives in each division are assigned a compatibility group letter by MOI or (Associate Administrator for Hazardous Materials Safety (DOT)) based on criteria specified by MOI or DOTn 49 CFR. Compatibility group letters are used to specify the controls for the transportation and storage related to various materials to prevent an increase in hazard that might result if certain types of explosives were stored or trans-ported together. Altogether, there are 35 possible classification codes for explosives, e.g., 1.1A, 1.3C, 1.4S, etc.

#### **E2.1.2 Compressed gases.** Examples include:

1. Flammable: acetylene, carbon monoxide, ethane, ethylene, hydrogen, methane. Ammonia will ignite and burn although its flammable range is too narrow for it to fit the definition of flammable gas.
2. Oxidizing: oxygen, ozone, oxides of nitrogen, chlorine and fluorine. Chlorine and fluorine do not contain oxygen but reaction with flammables is similar to that of oxygen.
3. Corrosive: ammonia, hydrogen chloride, fluorine.
4. Highly toxic: arsine, cyanogen, fluorine, germane, hydrogen cyanide, nitric oxide, phosphine, hydrogen selenide, stibine.
5. Toxic: chlorine, hydrogen fluoride, hydrogen sulfide, phosgene, silicon tetrafluoride.
6. Inert (chemically unreactive): argon, helium, krypton, neon, nitrogen, xenon.
7. Pyrophoric: diborane, dichloroborane, phosphine, silane.
8. Unstable (reactive): butadiene (unstabilized), ethylene oxide, vinyl chloride.

**E2.1.3 Flammable and combustible liquids.** Examples include:**1. Flammable liquids.**

Class IA liquids shall include those having flash points below 23°C and having a boiling point at or below 38°C.

Class IB liquids shall include those having flash points below 23°C and having a boiling point at or above 38°C.

Class IC liquids shall include those having flash points at or above 23°C and below 38°C.

**2. Combustible liquids.**

Class II liquids shall include those having flash points at or above 38°C and below 60°C.

Class IIIA liquids shall include those having flash points at or above 60°C and below 93°C.

Class IIIB liquids shall include those liquids having flash points at or above 93°C.

**E2.1.4 Flammable solids.** Examples include:**1. Organic solids:** camphor, cellulose nitrate, naphthalene.**2. Inorganic solids:** decaborane, lithium amide, phosphorous heptasulfide, phosphorous sesquisulfide, potassium sulfide, anhydrous sodium sulfide, sulfur.**3. Combustible metals (except dusts and powders):** cesium, magnesium, zirconium.**E2.1.5 Combustible dusts and powders.** Finely divided flammable solids which may be dispersed in air as a dust cloud: wood sawdust, plastics, coal, flour, powdered metals (few exceptions).**E2.1.6 Combustible fibers.** See Section 27.2.1.**E2.1.7 Oxidizers.** Examples include:**1. Gases:** oxygen, ozone, oxides of nitrogen, fluorine and chlorine (reaction with flammables is similar to that of oxygen).**2. Liquids:** bromine, hydrogen peroxide, nitric acid, perchloric acid, sulfuric acid.**3. Solids:** chlorates, chromates, chromic acid, iodine, nitrates, nitrites, perchlorates, peroxides.**E2.1.7.1 Examples of liquid and solid oxidizers according to hazard.**

Class 4: ammonium perchlorate (particle size greater than 15 microns), ammonium permanganate, guanidine nitrate, hydrogen peroxide solutions more than 91 percent by weight, perchloric acid solutions more than 72.5 percent by weight, potassium superoxide, tetranitromethane.

Class 3: ammonium dichromate, calcium hypochlorite (over 50 percent by weight), chloric acid (10 percent maximum concentration), hydrogen peroxide solutions (greater than 52 percent up to 91 percent), mono-(trichloro)-tetra-(monopotassium dichloro)-penta-s-triazinetriene, nitric acid, (fuming more than 86 percent concentration), perchloric acid solutions (60 percent to 72 percent by weight), potassium bromate, potassium chlorate, potassium dichloro-s-triazinetriene (potassium dichloro-isocyanurate), sodium bromate, sodium chlorate, sodium chlorite (over 40 percent by weight) and sodium dichloro-s-triazinetriene (sodium dichloro-isocyanurate).



Class 2: barium bromate, barium chlorate, barium hypochlorite, barium perchlorate, barium permanga-chlorate, calcium chlorite, calcium hypochlorite (50 percent or less by weight), calcium perchlorate, calcium permanganate, chromium trioxide (chromic acid), copper chlorate, halane (1, 3-dichloro-5, 5-dimethylhydantoin), hydrogen peroxide (greater than 27.5 percent up to 52 percent), lead perchlorate, lithium chlorate, lithium hypochlorite (more than 39 percent available chlorine), lithium perchlorate, magnesium bromate, magnesium chlorate, magnesium perchlorate, mercurous chlorate, nitric acid (more than 40 percent but less than 86 percent), perchloric acid solutions (more than 50 percent but less than 60 percent), potassium perchlorate, potassium permanganate, potassium peroxide, potassium superoxide, silver peroxide, sodium chlorite (40 percent or less by weight), sodium perchlorate, sodium perchlorate monohydrate, sodium permanganate, sodium peroxide, strontium chlorate, strontium perchlorate, thallium chlorate, trichloro-s-triazinetriene (trichloroisocyanuric acid), urea hydrogen peroxide, zinc bromate, zinc chlorate and zinc permanganate.

Class 1: all inorganic nitrates (unless otherwise classified), all inorganic nitrites (unless otherwise classified), ammonium persulfate, barium peroxide, calcium peroxide, hydrogen peroxide solutions (greater than 8 percent up to 27.5 percent), lead dioxide, lithium hypochlorite (39 percent or less available chlorine), lithium peroxide, magnesium peroxide, manganese dioxide, nitric acid (40 percent concentration or less), perchloric acid solutions (less than 50 percent by weight), potassium dichromate, potassium percarbonate, potassium persulfate, sodium carbonate peroxide, sodium dichloro-s-triazinetriene dihydrate, sodium dichromate, sodium perborate (anhydrous), sodium perborate monohydrate, sodium perborate tetrahydrate, sodium percarbonate, sodium persulfate, strontium peroxide and zinc peroxide.

**E2.1.8 Organic peroxides.** Organic peroxides contain the double oxygen or peroxy (-o-o) group. Some are flammable compounds and subject to explosive decomposition. They are available as:

1. Liquids.
2. Pastes.
3. Solids (usually finely divided powers).

**E2.1.8.1 Classification of organic peroxides according to hazard.**

Unclassified: Unclassified organic peroxides are capable of detonation and are regulated in accordance with Chapter 31.

Class I: acetyl cyclohexane sulfonyl 60-65 percent concentration by weight, fulfonyl peroxide, benzoyl peroxide over 98 percent concentration, t-butyl hydroperoxide 90 percent, t-butyl peroxyacetate 75 percent, t-butyl peroxyisopropylcarbonate 92 percent, diisopropyl peroxydicarbonate 100 percent, di-n-propyl peroxydicarbonate 98 percent, and di-n-propyl peroxydicarbonate 85 percent.

Class II: acetyl peroxide 25 percent, t-butyl hydroperoxide 70 percent (with DTBP and t-BuOH diluents), t-butyl peroxybenzoate 98 percent, t-butyl peroxy-2-ethylhexanoate 97 percent, t-butyl peroxyisobutyrate 75 percent, t-butyl peroxy-isopropyl-carbonate 75 percent, t-butyl peroxy-pivalate 75 percent, dybenzoyl peroxydicarbonate 85 percent, di-sec-butyl peroxydicarbonate 98 percent, di-sec-butyl peroxydicarbonate 75 percent, 1,1-di-(t-butylperoxy)-3,5,5-trimethyecyclo-

hexane 95 percent, di-(2-ethylhexyl) peroxydicarbonate 97 percent, 2,5-dimethyl-2,5-di-(benzoylperoxy) hexane 92 percent, and peroxyacetic acid 43 percent.

Class III: acetyl cyclohexane sulfonal peroxide 29 percent, benzoyl peroxide 78 percent, benzoyl peroxide paste 55 percent, benzoyl peroxide paste 50 percent peroxide/50 percent butylbenzylphthalate diluent, cumene hydroperoxide 86 percent, di-(4-butylcyclohexyl) peroxydicarbonate 98 percent, t-butyl peroxy-2-ethylhexanoate 97 percent, t-butyl peroxyneodecanoate 75 percent, decanoyl peroxide 98.5 percent, di-t-butyl peroxide 99 percent, 1,1-di-(t-butylperoxy)3,5,5-trimethylcyclohexane 75 percent, 2,4-dichlorobenzoyl peroxide 50 percent, diisopropyl peroxydicarbonate 30 percent, 2,5-dimethyl-2,5-di-(2-ethylhexanoly-peroxy)-hexane 90 percent, 2,5-dimethyl-2,5-di-(t-butylperoxy) hexane 90 percent and methyl ethyl ketone peroxide 9 percent active oxygen diluted in dimethyl phthalate.

Class IV: benzoyl peroxide 70 percent, benzoyl peroxide paste 50 percent peroxide/15 percent water/35 percent butylphthalate diluent, benzoyl peroxide slurry 40 percent, benzoyl peroxide powder 35 percent, t-butyl hydroperoxide 70 percent, (with water diluent), t-butyl peroxy-2-ethylhexanoate 50 percent, decumyl peroxide 98 percent, di-(2-ethylhexal) peroxydicarbonate 40 percent, laurel peroxide 98 percent, p-methane hydroperoxide 52.5 percent, methyl ethyl ketone peroxide 5.5 percent active oxygen and methyl ethyl ketone peroxide 9 percent active oxygen diluted in water and glycols.

Class V: benzoyl peroxide 35 percent, 1,1-di-t-butyl peroxy 3,5,5-trimethylcyclohexane 40 percent, 2,5-di-(t-butyl peroxy) hexane 47 percent and 2,4-pentanedione peroxide 4 percent active oxygen.

#### **E2.1.9 Pyrophoric materials.** Examples include:

1. Gases: diborane, phosphine, silane.
2. Liquids: diethylaluminum chloride, di-ethylberyllium, diethylphosphine, diethylzinc, dimethylarsine, triethylaluminum etherate, tri-ethyl-bismuthine, triethylboron, trimethylaluminum, trimethylgallium.
3. Solids: cesium, hafnium, lithium, white or yellow phosphorous, plutonium, potassium, rubidium, sodium, thorium.

#### **E2.1.10 Unstable (reactive) materials.** Examples include:

Class 4: acetyl peroxide, dibutyl peroxide, dinitrobenzene, ethyl nitrate, peroxyacetic acid and picric acid (dry) trinitrobenzene.

Class 3: hydrogen peroxide (greater than 52 percent), hydroxylamine, nitromethane, paranitroaniline, perchloric acid and tetrafluoroethylene monomer.

Class 2: acrolein, acrylic acid, hydrazine, methacrylic acid, sodium perchlorate, styrene and vinyl acetate.

Class 1: acetic acid, hydrogen peroxide 35 percent to 52 percent, paraldehyde and tetrahydrofuran.

#### **E2.1.11 Water-reactive materials.** Examples include:

Class 3: aluminum alkyls such as triethylaluminum, isobutylaluminum and trimethylaluminum; bromine pentafluoride, bromine trifluoride, chlorodiethyl-aluminium and diethylzinc.

Class 2: calcium carbide, calcium metal, cyanogen bromide, lithium hydride, methylchlorosilane, potassium metal, potassium peroxide, sodium metal, sodium peroxide, sulfuric acid and trichlorosilane.

Class 1: acetic anhydride, sodium hydroxide, sulfur monochloride and titanium tetrachloride.

**E2.1.12 Cryogenic fluids.** The cryogenics listed will exist as compressed gases when they are stored at ambient temperatures.

1. Flammable: carbon monoxide, deuterium (heavy hydrogen), ethylene, hydrogen, methane.
2. Oxidizing: fluorine, nitric oxide, oxygen.
3. Corrosive: fluorine, nitric oxide.
4. Inert (chemically unreactive): argon, helium, krypton, neon, nitrogen, xenon.
5. Highly toxic: fluorine, nitric oxide.

**E2.2 Health hazards.** Materials classified in this section pose a health hazard.

**E2.2.1 Highly toxic materials.** Examples include:

1. Gases: arsine, cyanogen, diborane, fluorine, germane, hydrogen cyanide, nitric oxide, nitrogen dioxide, ozone, phosphine, hydrogen selenide, stibine.
2. Liquids: acrolein, acrylic acid, 2-chloroethanol (ethylene chlorohydrin), hydrazine, hydrocyanic acid, 2-methylaziridine (propylenimine), 2-methyl-acetonitrile (acetone cyanohydrin), methyl ester isocyanic acid (methyl isocyanate), nicotine, tetranitromethane and tetraethylstannane (tetraethyltin).
3. Solids: (aceto) phenylmercury (phenyl mercuric acetate), 4-amino-pyridine, arsenic pentoxide, arsenic trioxide, calcium cyanide, 2-chloro-acetophenone, aflatoxin B, decaborane(14), mercury (II) bromide (mercuric bromide), mercury (II) chloride (corrosive mercury chloride), pentachlorophenol, methyl parathion, phosphorus (white) and sodium azide.

**E2.2.2 Toxic materials.** Examples include:

1. Gases: boron trichloride, boron trifluoride, chlorine, chlorine trifluoride, hydrogen fluoride, hydrogen sulfide, phosgene, silicon tetrafluoride.
2. Liquids: acrylonitrile, allyl alcohol, alpha-chlorotoluene, aniline, 1-chloro-2,3-epoxypropane, chloroformic acid (allyl ester), 3-chloropropene (allyl chloride), o-cresol, crotonaldehyde, dibromo-methane, diisopro-pylamine, diethyl ester sulfuric acid, dimethyl ester sulfuric acid, 2-furaldehyde (furfural), furfural alcohol, phosphorus chloride, phosphoryl chloride (phosphorus oxychloride) and thionyl chloride.
3. Solids: acrylamide, barium chloride, barium (II) nitrate, benzidine, p-benzoquinone, beryllium chloride, cadmium chloride, cadmium oxide, chloroacetic acid, chlorophenylmercury (phenyl mercuric chloride), chromium (VI) oxide (chromic acid, solid), 2,4-dinitrotoluene, hydroquinone, mercury chloride (calomel), mercury (II) sulfate (mercuric sulfate), osmium tetroxide, oxalic acid, phenol, P-phenylenediamine, phenylhydrazine, 4-phenyl-morpholine, phosphorus sulfide, potassium fluoride, potassium hydroxide, selenium (IV) disulfide and sodium fluoride.

**E2.2.3 Corrosives.** Examples include:

1. Acids: Examples: chromic, formic, hydrochloric (muriatic) greater than 15 percent, hydrofluoric, nitric (greater than 6 percent, perchloric, sulfuric (4 percent or more).

2. Bases (alkalis): hydroxides—ammonium (greater than 10 percent), calcium, potassium (greater than 1 percent), sodium (greater than 1 percent); certain carbonates—potassium.
3. Other corrosives: bromine, chlorine, fluorine, iodine, ammonia.  
**Note:** Corrosives that are oxidizers, e.g., nitric acid, chlorine, fluorine; or are compressed gases, e.g., ammonia, chlorine, fluorine; or are water-reactive, e.g., concentrated sulfuric acid, sodium hydroxide, are physical hazards in addition to being health hazards.

### SECTION E3 EVALUATION OF HAZARDS

- E3.1 Degree of hazard.** The degree of hazard present depends on many variables which should be considered individually and in combination. Some of these variables are as shown in Sections E3.1.1 through E3.1.5.
- E3.1.1 Chemical properties of the material.** Chemical properties of the material determine self reactions and reactions which may occur with other materials. Generally, materials within subdivisions of hazard categories will exhibit similar chemical properties. However, materials with similar chemical properties may pose very different hazards.  
 Each individual material should be researched to determine its hazardous properties and then considered in relation to other materials that it might contact and the surrounding environment.
- E3.1.2 Physical properties of the material.** Physical properties, such as whether a material is a solid, liquid or gas at ordinary temperatures and pressures, considered along with chemical properties will determine requirements for containment of the material. Specific gravity (weight of a liquid compared to water) and vapor density (weight of a gas compared to air) are both physical properties which are important in evaluating the hazards of a material.
- E3.1.3 Amount and concentration of the material.** The of material present and its concentration must be considered along with physical and chemical properties to determine the magnitude of the hazard. Hydrogen peroxide, for example, is used as an antiseptic and a hair bleach in low concentrations (approximately 8 percent in water solution). Over 8 percent, hydrogen peroxide is classed as an oxidizer and is toxic. Above 90 percent, it is a Class 4 oxidizer “that can undergo an explosive reaction when catalyzed or exposed to heat, shock or friction,” a definition which incidentally also places hydrogen peroxide over 90 percent concentration in the unstable (reactive) category. Small amounts at high concentrations may present a greater hazard than large amounts at low concentrations.
- E3.1.3.1 Mixtures.** Gases—toxic and highly toxic gases include those gases which have an  $LC_{50}$  of 2,000 parts per million (ppm) or less when rats are exposed for a period of 1 hour or less. To maintain consistency with the definitions for these materials, exposure data for periods other than 1 hour must be normalized to 1 hour. To classify mixtures of compressed gases that contain one or toxic or highly toxic components, the  $LC_{50}$  of the mixture must be determined. Mixtures that contain only two components are binary mixtures. Those that contain more than two components are multi-component mixtures. When two or more hazardous substances (components) having an  $LC_{50}$  below 2,000 ppm are present in a their combined effect, rather than that of the individual substances (components), must

be considered. In the absence of information to the contrary, the effects of the hazards present must be considered as additive. Exceptions to the above rule may be made when there is a good reason to believe that the principal effects of the different harmful substances (components) are not additive.

For binary mixtures where the hazardous component is diluted with a nontoxic gas such as an inert gas, the  $LC_{50}$  of the mixture is estimated by use of the following formula:

$$LC_{50m} = \frac{1}{[C_i / LC_{50i}]} \quad \text{(Equation E-1)}$$

For multi-component mixtures where more than one component has a listed  $LC_{50}$ , the  $LC_{50}$  of the mixture is estimated by use of the following formula:

$$C_{50m} = \frac{1}{(C_{i1} / LC_{50i1}) + (C_{i2} / LC_{50i2}) + (C_{in} / LC_{50i})} \quad \text{(Equation E-2)}$$

Where:

$LC_{50m}$   $LC_{50}$  of the mixture in parts per million (ppm).

$C_i$  concentration of component (i) in decimal percent. The concentration of the individual components in a mixture of gases is to be expressed in terms of percent by volume.

$LC_{50i}$   $LC_{50}$  of component (i). The  $LC_{50}$  of the component is based on a 1-hour exposure.  $LC_{50}$  data which are for other than 1-hour exposures shall be normalized to 1-hour by multiplying the  $LC_{50}$  for the time determined by the factor indicated in Table E3.1.3.1. The preferred mammalian species for  $LC_{50}$  data is the rat, as specified in the definitions of toxic and highly toxic in Chapter 1 of the *Saudi Fire Code*. If data for rats are unavailable, and in the absence of information to the contrary, data for other species may be utilized. The data shall be taken in the following order of preference: rat, mouse, rabbit, guinea pig, cat, dog, monkey.

$i_n$  component 1, component 2 and so on to the nth component.

#### Examples:

- a. What is the  $LC_{50}$  of a mixture of 15-percent chlorine, 85-percent nitrogen?  
The 1-hour (rat)  $LC_{50}$  of pure chlorine is 293 ppm.  
 $LC_{50m} = 1 / (0.15 / 293)$  or 1,953 ppm. Therefore, the mixture is toxic.
- b. What is the  $LC_{50}$  of a mixture of 15-percent chlorine, 15-percent fluorine and 70-percent nitrogen?  
The 1-hour (rat)  $LC_{50}$  of chlorine is 293 ppm. The 1-hour (rat)  $LC_{50}$  of fluorine is 185 ppm.  
 $LC_{50m} = 1 / (0.15 / 293) + (0.15 / 185)$  or 755 ppm. Therefore the mixture is toxic.
- c. Is the mixture of 1 percent phosphine in argon toxic or highly toxic?  
The 1-hour (rat)  $LC_{50}$  is 11 ppm.  
 $LC_{50m} = 1 / [0.01 / (11 \cdot 2)]$  or 2,200 ppm. Therefore the mixture is neither toxic nor highly toxic. Note that the 4-hour  $LC_{50}$  of 11 ppm was normalized to 1-hour by use of E3.1.3.1.

**TABLE E3.1.3.1**  
**NORMALIZATION FACTOR**

<b>TIME (hours)</b>	<b>MULTIPLY BY</b>
0.5	0.7
1.0	1.0
1.5	1.2
2.0	1.4
3.0	1.7
4.0	2.0
5.0	2.2
6.0	2.4
7.0	2.6
8.0	2.8

**E3.1.4 Actual use, activity or process involving the material.** The definition of handling, storage and use in closed systems refers to materials in packages or containers. Dispensing and use in open containers or systems describes situations where a material is exposed to ambient conditions or vapors are liberated to the atmosphere. Dispensing and use in open systems, then, are generally more hazardous situations than handling, storage or use in closed systems. The actual use or process may include heating, electric or other sparks, catalytic or reactive materials and many other factors which could affect the hazard and must therefore be thoroughly analyzed.

**E3.1.5 Surrounding conditions.** Conditions such as other materials or processes in the area, type of construction of the structure, fire protection features (e.g., fire walls, sprinkler systems, alarms, etc.), occupancy (use) of adjoining areas, normal temperatures, exposure to weather, etc., must be taken into account in evaluating the hazard.

**E3.2 Evaluation questions.** The following are sample evaluation questions:

1. What is the material? Correct identification is important; exact spelling is vital. Check labels, MSDS, ask responsible persons, etc.
2. What are the concentration and strength?
3. What is the physical form of the material? Liquids, gases and finely divided solids have differing requirements for spill and leak control and containment.
4. How much material is present? Consider in relation to permit amounts, maximum allowable quantity per control area (from Group H occupancy requirements), amounts which require detached storage and overall magnitude of the hazard.
5. What other materials (including furniture, equipment and building components) are close enough to interact with the material?
6. What are the likely reactions?
7. What is the activity involving the material?
8. How does the activity impact the hazardous characteristics of the material? Consider vapors released or hazards otherwise exposed.

9. What must the material be protected from? Consider other materials, temperature, shock, pressure, etc.
10. What effects of the material must people and the environment be protected from?
11. How can protection be accomplished? Consider:
  - 11.1 Proper containers and equipment.
  - 11.2 Separation by distance or construction.
  - 11.3 Enclosure in cabinets or rooms.
  - 11.4 Spill control, drainage and containment.
  - 11.5 Control systems – ventilation, special electrical, detection and alarm, extinguishment, explosion venting, limit controls, exhaust scrubbers and excess flow control.
  - 11.6 Administrative (operational) controls—signs, ignition source control, security, personnel training, established procedures, storage plans and emergency plans. Evaluation of the hazard is a strongly subjective process; therefore, the person charged with this responsibility must gather as much relevant data as possible so that the decision will be objective and within the limits prescribed in laws, policies and standards. It may be necessary to cause the responsible persons in charge to have tests made by qualified persons or testing laboratories to support contentions that a particular material or process is or is not hazardous. See SBC 100.

## APPENDIX F HAZARD RANKING

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

### SECTION F1 GENERAL

- F1.1 Scope.** Assignment of levels of hazards to be applied to specific hazard classes as required by NFPA 704 shall be in accordance with this appendix. The appendix is based on application of the degrees of hazard as defined in NFPA 704 arranged by hazard class as for specific categories defined in these code requirements and used throughout.
- F1.2 General.** The hazard rankings shown in Table F1.2 have been established by using guidelines found within NFPA 704. As noted in Section 1-5 of NFPA 704, there could be specific reasons to alter the degree of hazard assigned to a specific material; for example, ignition temperature, flammable range or susceptibility of a container to rupture by an internal combustion explosion or to metal failure while under pressure or because of heat from external fire. As a result, the degree of hazard assigned for the same material can vary when assessed by different people of equal competence.
- The hazard rankings assigned to each class represent reasonable minimum hazard levels for a given class based on the use of criteria established by NFPA 704. Specific cases of use or storage may dictate the use of higher degrees of hazard in certain cases.

### SECTION F2 REFERENCED STANDARDS

SBC	SFC	Saudi Fire Code	F1.1
NFPA	704	Identification of the Hazards of Materials for Emergency Response	F1.1, F1.2



**TABLE F1.2**  
**FIRE FIGHTER WARNING PLACARD DESIGNATIONS BASED ON HAZARD**  
**CLASSIFICATION CATEGORIES**

HAZARD CATEGORY	DESIGNATION
Combustible liquid II	F2
Combustible liquid IIIA	F2
Combustible liquid IIIB	F1
Combustible dust	F4
Combustible fiber	F3
Cryogenic flammable	F4, H3
Cryogenic oxidizing	OX, H3
Explosive	R4
Flammable solid	F2
Flammable gas (gaseous)	F4
Flammable gas (liquefied)	F4
Flammable liquid IA	F4
Flammable liquid IB	F3
Flammable liquid IC	F3
Organic peroxide, UD	R4
Organic peroxide I	F4, R3
Organic peroxide II	F3, R3
Organic peroxide III	F2, R2
Organic peroxide IV	F1, R1
Organic peroxide V	Nonhazard
Oxidizing gas (gaseous)	OX
Oxidizing gas (liquefied)	OX
Oxidizer 4	OX
Oxidizer 3	OX
Oxidizer 2	OX
Pyrophoric gases	F4
Pyrophoric solids, liquids	F3
Unstable reactive 4D	R4
Unstable reactive 3D	R4
Unstable reactive 3N	R3
Unstable reactive 2	R2
Water reactive 3	W, R3
Water reactive 2	W, R2
Corrosive	H3, COR
Toxic	H3
Highly toxic	H4

F—Flammable category.

R—Reactive category.

H—Health category.

W—Special hazard: water reactive.

OX—Special hazard: oxidizing properties.

COR—Corrosive.

UD—Unclassified detonable material.

4D—Class 4 detonable material.

3D—Class 3 detonable material.

3N—Class 3 nondetonable material.

**APPENDIX G**  
**CRYOGENIC FLUIDS – WEIGHT AND VOLUME EQUIVALENTS**

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

**SECTION G1**  
**GENERAL**

- G1.1**      **Scope.** This appendix is used to convert from liquid to gas for cryogenic fluids.
- G1.2**      **Conversion.** Table G1.2 shall be used to determine the equivalent amounts of cryogenic fluids in either the liquid or gas phase.
- G1.2.1**    **Use of the table.** To use Table G1.2, read horizontally across the line of interest. For example, to determine the number of cubic metres of gas contained in 3.785 L of liquid argon, find 3.785 L in the column entitled “Volume of Liquid at Normal Boiling Point.” Reading across the line under the column entitled “Volume of Gas at 21°C and 1 atmosphere 101.36 kPa,” the value of 3,184 m<sup>3</sup> is found.
- G1.2.2**    **Other quantities.** If other quantities are of interest, the numbers obtained can be multiplied or divided to obtain the quantity of interest. For example, to determine the number of cubic metre of argon gas contained in a volume of 3,785 L of liquid argon at its normal boiling point, multiply 3.2 by 1,000 to obtain 3,200 m<sup>3</sup>.

**TABLE G1.2**  
**WEIGHT AND VOLUME EQUIVALENTS FOR COMMON CRYOGENIC FLUIDS<sup>a</sup>**

<b>CRYOGENIC FLUID</b>	<b>WEIGHT OF LIQUID OR GAS Kilograms</b>	<b>VOLUME OF LIQUID AT NORMAL BOILING POINT Liters</b>	<b>VOLUME OF GAS AT 21°C AND 1 ATMOSPHERE 101.36 kPa Cubic meters</b>
<b>Argon</b>	0.454	0.326	0.274
	1.000	0.718	0.604
	1.393	1.000	0.841
	5.274	3.785	3.184
	4.690	3.366	2.832
	1.656	1.189	1.000
<b>Helium</b>	0.454	3.631	2.739
	1.000	8.006	6.038
	0.125	1.000	0.754
	0.473	3.785	2.855
	0.469	3.754	2.832
	0.166	1.326	1.000
<b>Hydrogen</b>	0.454	6.409	5.436
	1.000	14.130	11.984
	0.071	1.000	0.848
	0.268	3.785	3.210
	0.236	3.339	2.832
	0.083	1.179	1.000
<b>Oxygen</b>	0.454	0.397	0.342
	1.000	0.876	0.754
	1.142	1.000	0.861
	4.321	3.785	3.250
	3.756	3.290	2.832
	1.327	1.162	1.000
<b>Nitrogen</b>	0.454	0.561	0.391
	1.000	1.237	0.862
	0.808	1.000	0.697
	3.060	3.785	2.637
	3.286	4.065	2.832
	1.160	1.436	1.000
<b>LNG1</b>	0.454	1.052	0.650
	1.000	2.320	1.434
	0.431	1.000	0.618
	1.633	3.785	2.340
	1.976	4.580	2.832
	5.217	1.616	1.000

a. The values listed for liquefied natural gas (LNG) are “typical” values. LNG is a mixture of hydrocarbon gases, and no two LNG streams have exactly the same composition.